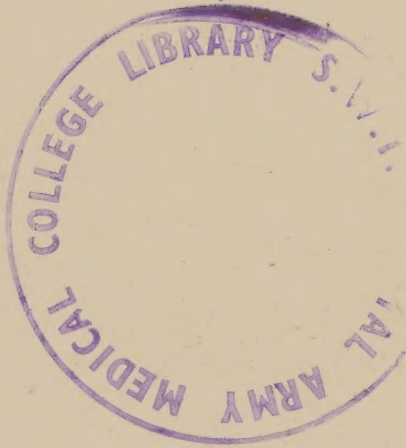



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GEOGRAPHICAL HANDBOOK SERIES  
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# FRANCE

VOLUME IV

PORTS AND COMMUNICATIONS

*October 1942*

NAVAL INTELLIGENCE DIVISION



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## PREFACE

**I**N 1915 a Geographical Section was formed in the Naval Intelligence Division of the Admiralty to write Geographical Handbooks on various parts of the world. The purpose of these handbooks was to supply, by scientific research and skilled arrangement, material for the discussion of naval, military, and political problems, as distinct from the examination of the problems themselves. Many distinguished collaborators assisted in their production, and by the end of 1918 upwards of fifty volumes had been produced in Handbook and Manual form, as well as numerous short-term geographical reports. The demand for these books increased rapidly with each new issue, and they acquired a high reputation for accuracy and impartiality. They are now to be found in Service Establishments and Embassies throughout the world, and in the early years after the last war were much used by the League of Nations.

The old Handbooks have been extensively used in the present war, and experience has disclosed both their value and their limitations. On the one hand they have proved, beyond all question, how greatly the work of the fighting services and of Government Departments is facilitated if countries of strategic or political importance are covered by handbooks which deal, in a convenient and easily digested form, with their geography, ethnology, administration, and resources. On the other hand, it has become apparent that something more is needed to meet present-day requirements. The old series does not cover many of the countries closely affected by the present war (e.g. Germany, France, Poland, Spain, Portugal, to name only a few); its books are somewhat uneven in quality, and they are inadequately equipped with maps, diagrams, and photographic illustrations.

The present series of Handbooks, while owing its inspiration largely to the former series, is in no sense an attempt to revise or re-edit that series. It is an entirely new set of books, produced in the Naval Intelligence Division by trained geographers drawn largely from the Universities, and working at sub-centres established at Oxford and Cambridge, and is printed by the Oxford and Cambridge University Presses. The books follow, in general, a uniform scheme, though minor modifications will be found in particular cases; and they are furnished with numerous maps and illustrations. At the present time books covering over thirty-five countries are in course



of preparation, and this list will be substantially extended by the end of 1942.

The purpose of the books is primarily naval. They are designed first to provide, for the use of Commanding Officers, information in a comprehensive and convenient form about countries which they may be called upon to visit, not only in war but in peace-time; secondly, to maintain the high standard of education in the Navy and, by supplying officers with material for lectures to naval personnel ashore and afloat, to ensure for all ranks that visits to a new country shall be both interesting and profitable.

Their contents are, however, by no means confined to matters of purely naval interest. For many purposes (e.g. history, administration, resources, communications, etc.) countries must necessarily be treated as a whole, and no attempt is made to limit their treatment exclusively to coastal zones. It is hoped therefore that the Army, the Royal Air Force, and other Government Departments (many of whom have given great assistance in the production of the series) will find these Handbooks even more valuable than their predecessors proved to be both during and after the war of 1914-18.

This volume has been prepared for the Naval Intelligence Division at the Cambridge sub-centre (Director, Mr J. M. Wordie; General Editor, Dr H. C. Darby). It has been written by Mr S. H. Beaver, Mr F. J. Monkhouse, Mr F. W. Morgan, Mr A. C. O'Dell and Dr Hilda Ormsby, with contributions from Admiral Sir Herbert Richmond. The maps and diagrams have been executed by Miss Margaret Alexander, Mr D. Baldwin, Miss K. S. Froggatt, Mr C. R. Haynes and Mrs Gwen Raverat.

J. H. GODFREY

*Director of Naval Intelligence*

*October 1942*



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## Chapter I

### CHANNEL PORTS

Introduction: Note on Terms employed: Dunkirk: Calais: Boulogne: Dieppe: Havre: Rouen: Subsidiary Ports of the Lower Seine: Caen: Cherbourg; St Malo-St Servan: Minor Channel Ports

#### INTRODUCTION

‘No country’, it has been said, ‘is so well endowed with natural harbours as France.’ With a long coastline, close to some of the busiest shipping routes in the world, France possesses many active ports, although none is comparable with London, Antwerp or Rotterdam.

In their physical setting, the ports of France show a very great variety, for hardly any two are alike. Natural advantages have been utilized where possible, but in many ports great engineering works have had to be carried out to overcome physical drawbacks and to accommodate large ships. Rouen, Nantes and Bordeaux are situated on great rivers some distance from the sea, but there is little real similarity in their river approaches. Though the Seine will not permit the entry of large vessels into Rouen, it has offered little obstacle to the development of an enormous traffic of cargo ships, and further deepening is feasible. Nantes, on the other hand, wages a continual battle to maintain the Loire channel for present-day traffic, and there is some doubt whether much improvement can be effected in the future. Bordeaux has been able to maintain a deep channel in the Gironde, but a few years ago it became necessary to undertake one of the most extensive dredging operations in port history to keep open the seaward entrance.

Dunkirk lies upon a low and shelving coast, encumbered with sandbanks, but its approaches are less costly to maintain than those of some ports. Havre and St Nazaire lie at the mouths of great estuaries and have to deal mainly with problems of silting and the maintenance of channels through offshore banks. At Marseilles the approaches are of unequalled convenience, and there is no serious problem of depths. The harbour, however, has literally been constructed on the sea bed by the laying down of enormous underwater ramparts of stone. At Cherbourg even the two roadsteads are



artificial. Another type of port site has come into prominence in the past twenty years, for extensive wharves for sea-going ships are being developed along the shores of the *étangs* or lagoons near Marseilles and Sète. Two of the finest natural harbours are the extensive deep-water roadsteads of Brest and Toulon, but these are devoted mainly to naval use and are not well located for commercial ports.

The word 'artificial' is, in fact, misleading when employed in connexion with ports, for it is a purely relative term. The governing factors in port development are, indeed, not those arising from the physical background of the coast, but the economic demands of the hinterland, the energy of trading communities and the policy of the state. In France a single act of legislation, ordering the setting up of a complete petroleum refining industry, had far-reaching effects upon port expansion. Often, too, developments far distant from a port affect its prosperity: Dunkirk, for example, is vitally concerned in the competitive policies of Rotterdam and Antwerp and in the improvements of the river and canal connexions of Strasbourg.

### *Weather and Tides*

Meteorological conditions play their part in affecting the use of French ports, as with those of other countries, but owing to the moderate latitude of the country and to its westward location in Europe, they are never very adverse.\* On the western Channel and north Biscayan coasts winter gales are more frequent than farther

	Av. no. days in year with fog			Av. no. days in year with fog	
St Inglevert, nr. Calais	101	Winter maximum	Nantes	36	Winter maximum
Havre	52	Winter maximum	Rochefort	52	Winter maximum
Cherbourg	14	All the year round	Bordeaux	84	Winter maximum
Brest	34	Summer maximum	St Jean-de-Luz	6	Winter maximum
Lorient	55	Winter maximum	Marseilles	9	Winter maximum
Penmarc'h	51	Winter maximum	Nice	24	Summer maximum

east or south. In the Mediterranean the Golfe du Lion is notorious for sudden changes of weather: in addition to the winds normally associated with winter depressions, there are local winds which can raise heavy seas quickly and interfere with navigation, the *mistral*, the *marin* and the *gregal*. Winds of *mistral* type have been recorded at Marseilles for an average of 110 days in the year. Owing to the

\* For a full account of meteorological conditions see Vol. I, Chapter III.

occurrence of the *mistral* in the Golfe du Lion, Port-Vendres, the most westerly of the French Mediterranean ports, enjoys an advantage in the north African packet trade, for it offers the most comfortable crossing to Oran and Algiers. Fog often occurs off the big ports owing to the presence of smoke in the atmosphere, but a variety of other factors complicate the distribution of fog over a coast. Much of the fog of the Brittany coast is really a fine drizzle. On the Mediterranean, morning mist is frequent in calm weather and occasionally fails to be dispersed by the sun and so lasts all day.

Tides are hardly experienced on the Mediterranean coast of France. Variations in the level of the sea are most obviously affected by weather conditions, and in some harbours the effect of variations of atmospheric pressure upon the water level is clearly observable. On the tidal Biscayan and Channel coasts the amplitude of the tide varies considerably. South of the Loire the range is least, varying from 4·8 m. (15·7 ft.) at St Jean-de-Luz to 6·3 m. (20·7 ft.) at the mouth of the estuary (range between high and low water at the highest spring tides). Along the Atlantic coast of Brittany the range increases steadily, reaching 7·7 m. (25·2 ft.) at Brest.

In the Channel the tides along the French shore have a far greater range than those on the English shore. The bay between the north coast of Brittany and the Cotentin peninsula, with narrowing coasts and shelving bottom, experiences a very great range, reaching a maximum of 15·4 m. (50·5 ft.) at Cancale. At St Malo, nearby, the range is 13·5 m. (44·3 ft.). Beyond Cap de la Hague the range is reduced in Baie de la Seine, reaching 8·4 m. (27·5 ft.) at Havre, but it increases again in the shallow inward curve of the coast between Fécamp and Boulogne, reaching a maximum of 11·2 m. (36·7 ft.) at Le Tréport, and 10·0 m. (32·8 ft.) at Boulogne. The range then diminishes to 6·4 m. (21 ft.) at Dunkirk, and 6·75 m. (19·8 ft.) at Gravelines. The greatest range on the English Channel coast, about 8·0 m. (26 ft.), occurs near Dungeness, and the least range, about 0·9 m. (3·25 ft.), near Poole.

In the entrance to the English Channel the co-tidal lines run nearly transversely across the general direction of the channel; high water is consequently nearly simultaneous at opposite points on the English and French coasts. Farther in, near Cherbourg, the lines swing round and eventually become longitudinal to the channel. High waters occur nearly simultaneously at St Valéry and St Catherine's Point, and still farther in there is no appreciable change in the time of high water over a very considerable area.



At the mouth of the Seine the duration of high water is much longer than elsewhere, for a 'double maximum' occurs. A stand of tide of about 3 hr. duration occurs at Havre at high water; the

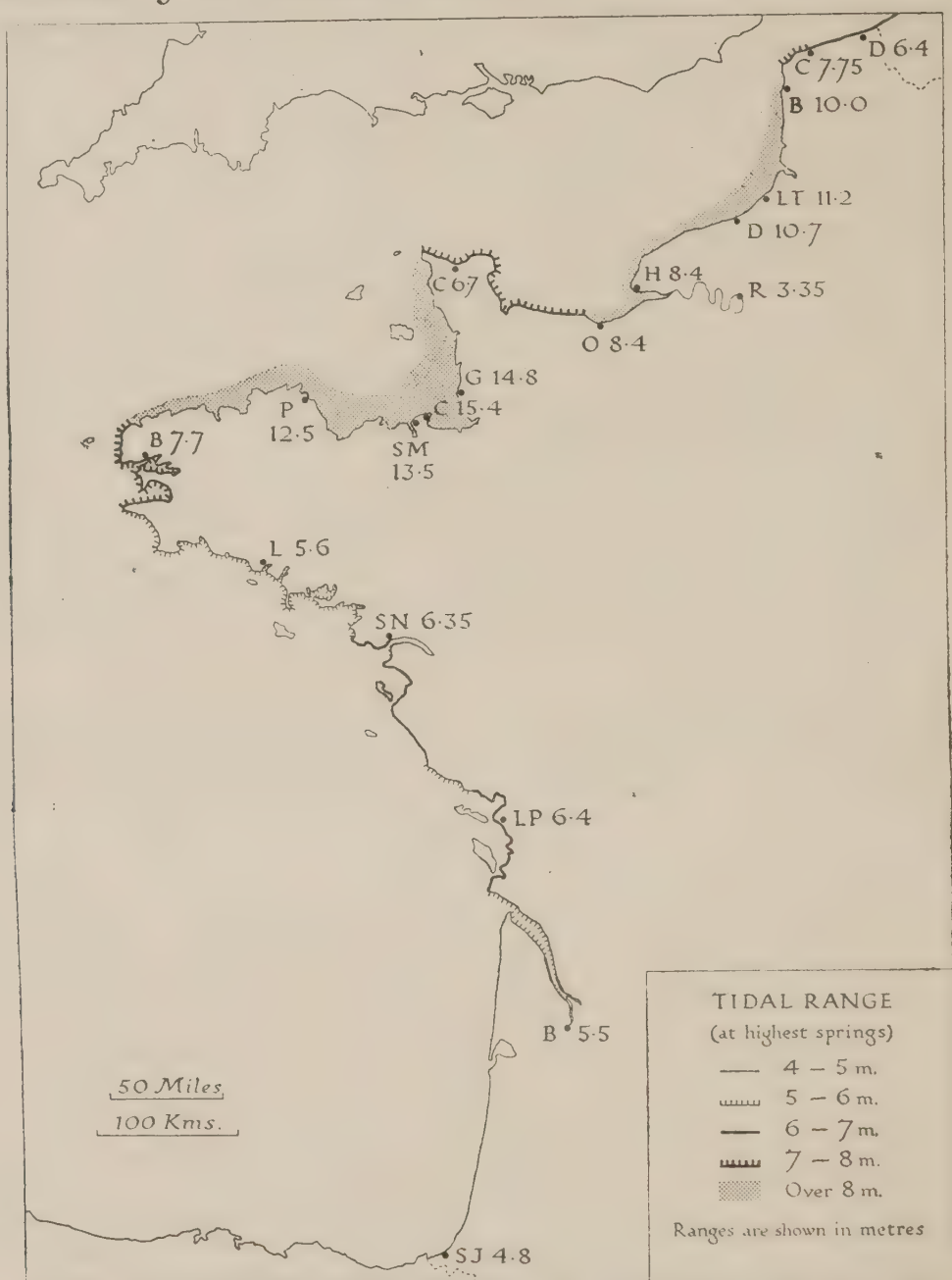


Fig. 1. Tidal ranges on the Atlantic and Channel coasts of France

Reading from the north, the names indicated by the initials are as follows: D, Dunkirk; C, Calais; B, Boulogne; LT, Le Tréport; D, Dieppe; H, Havre; R, Rouen; O, Ouistreham (entrance to the Canal Maritime de Caen à la Mer); C, Cherbourg; G, Granville; C, Cancale; SM, St Malo; P, Paimpol; B, Brest; L, Lorient; SN, St Nazaire; LP, La Pallice; B, Bordeaux; SJ, St Jean-de-Luz.

duration of fall is generally lengthened and that of rise correspondingly shortened. As a result the passing of vessels into the docks at Havre is very much simplified, and the tidal basins of the port can conveniently receive the largest ships afloat.

### *Port Operation*

In port operation French practice is normally not very different from practice elsewhere. Apart from those which lie up rivers, the ports are all provided with an *avant-port*, or outer harbour, an area of water protected by converging jetties for the use of vessels waiting to berth. Sometimes passengers and small parcels of merchandise are landed here. The *avant-port* is large enough to kill the swell which enters between the jetty heads and long enough to allow vessels to enter easily and to lose way before reaching the locks; for this purpose a length of 500 m. is sufficient at St Nazaire and 600 m. at La Pallice, whereas a length of 1,200 m. is required at Havre to accommodate the *Normandie*. The width is sufficient to reduce the development of currents between the jetty heads, and to allow convenient manœuvring of ships. In the ports of the Channel and Biscayan coasts the wet dock (*Bassin à Flot*) is a standard feature in the inner harbour, but the tidal basin (*Bassin de Marée*) is employed for passenger traffic, where a quick turn round is essential, at Cherbourg, Havre and the Channel ferry ports. The wet dock tends to make for delay in ship handling owing to the limitations of the time of access at high water; the tidal basin eliminates much of this difficulty but introduces problems of cargo handling and of mooring owing to changes in the water level. At Havre the long duration of high water which makes the tidal basin convenient also simplifies the locking of ships which berth in the wet docks; at Dunkirk there is a greater need to conserve water, and a divided lock is used when possible. St Malo, with its great tidal range, requires lock gates pointing seawards as well as landwards. The ports which lie on rivers some distance from the sea generally dispense with wet docks, although there are two docks at Bordeaux. Of the coastal ports Bayonne has less need of wet docks, for its tidal range is the smallest of any Atlantic or Channel port, but Brest, with a much greater range, has so far succeeded in carrying on a considerable cargo traffic without the employment of such docks. On the tideless Mediterranean, wet docks are unnecessary and port operation is greatly simplified.

For speedy removal of passengers and merchandize it is clear that an adequate equipment of railways is essential. The enormous demands for rapid discharge which were experienced during the war of 1914-18 revealed the inadequacy of rail facilities at many French ports, and since then tracks and sidings have been greatly extended. The relief of the country behind a port is an important factor in the establishment of communications, but does not always determine the



prosperity of a port. The possibility of traffic is often sufficient to encourage great undertakings like tunnels and cuttings. Generally speaking, the Mediterranean ports suffer owing to the proximity of mountains to the coast, and at Port-Vendres the problem is acute. Marseilles has undertaken extensive works, such as the construction of the Rove canal tunnel, to improve its connexion with the hinterland, but here the established importance of the port justified the enormous outlay. Railway connexions for Marseilles also involved the elaborate works of the Nerthe tunnel and the Caronte viaduct. The railway from Cherbourg experiences steep gradients, which demand the use of extremely powerful locomotives (see p. 309). It is clear that in proximity to a populous hinterland, Rouen and Dunkirk are most fortunate among the French ports.

Technically the port works of France are probably as interesting as any in the world, and contain many unusual features of construction. At some ports, interest centres upon the magnitude of the works undertaken: the breakwaters and moles at Marseilles, the new dock and the breakwaters at Cherbourg are all impressive examples of harbour structures. The mole at La Pallice and the pier at Le Verdon required the solution of many interesting problems of pier construction and foundation work. In the Etang de Caronte and Etang de Berre the outlines of land and water are in course of transformation by enormous dredging and reclamation operations. Other works are of more interest for their ingenuity, like the construction dock and the lock-dry dock at St Nazaire, or the apparatus along the pier face at Le Verdon, which prevents the rolling of any moored vessel from causing damage to the hull or to the pier. The maintenance of the channels and passes of the Gironde requires very elaborate investigation of bank movements. Indeed, the problems of port maintenance and operation have given full scope to French mathematical and engineering ability.

The administration of French ports is very different from the administration of English ports, for they are under the authority of the Minister of Public Works. There are no autonomous public corporations like the Port of London Authority, the Mersey Docks and Harbour Board, or the Clyde Trust, and no ports were owned or operated by the railways before the companies were nationalized. The Chambers of Commerce are naturally the driving force behind the demand for improvement at individual ports, and the governing body of the economic region in which a port is situated also exercises a paternal interest. Overriding local interests, however, is the general

supervision of the state. There have been changes in the status of ports, and while local independence was extended for a time, state control has once more been established. Havre and Bordeaux were

*Net Tonnage entered and cleared in Foreign Trade, 1937*

	No. of ships	Net tonnage (thousands of tons)		No. of ships	Net tonnage (thousands of tons)
Marseilles	9,368	26,085.6	<i>Minor Ports</i>		
Bouc	1,071	2,284.5	Monaco	53	217.9
La Mède	95	338.6	Fécamp	264	133.7
Havre	5,817	20,725.6	Granville	211	115.0
Cherbourg (inc. Carentan)	1,106	14,645.4	La Nouvelle	121	98.5
Dunkirk	5,191	8,181.4	Le Tréport	235	93.6
Rouen	7,263	7,973.1	Gravelines	747	87.4
Honfleur (inc. Quillebeuf)	295	141.1	Trouville-Deauville	189	76.7
Villequier	13	31.9	Le Légué (inc. Dahouet)	306	72.4
Duclair (inc. Caudebec)	43	22.8	Cannes and Golfe Juan	33	60.2
Le Trait entrepôt	16	20.7	Les Sables d'Olonne	116	60.0
Port Jérôme	69	85.8	St Raphaël	49	46.2
Boulogne	4,922	7,192.3	Morlaix	143	32.8
Bordeaux	3,212	4,822.5	Roscoff	171	28.3
Mortagne (inc. Royan)	21	7.4	Arcachon	28	25.9
Pauillac-Trompeloup	152	600.2	Quimper	123	22.3
Blaye	109	137.7	Cassis	30	19.1
Furt	3	13.8	Paimpol (inc. Perros Guirée)	114	18.9
Bec d'Ambes	95	363.9	Vannes	109	18.2
Calais	3,918	2,889.5	Douarnenez	73	10.6
Nantes	1,626	2,081.0	Lannion	49	8.5
Basse Indre	106	131.5	St Tropez	12	8.0
Couéron	20	32.0	Tréguier	47	7.9
Paimboeuf	28	18.5	Marans	15	7.4
Donges	103	332.6	Loctudy	44	6.3
St Nazaire	496	864.5	Concarneau	36	4.5
Dieppe	3,050	2,065.8	Isigny-sur-Mer	19	4.4
Sète	1,969	1,996.8	Menton	5	4.3
La Pallice	871	1,536.2	Courseulles	15	4.2
La Rochelle	850	216.0	Antibes	44	4.2
Toulon	234	1,145.3	La Trinité	29	3.7
La Seyne	48	36.2	Landerneau	24	3.4
Caen	1,134	1,054.6	St Valéry-sur-Somme	16	3.2
Port-Vendres	666	1,018.7	Quiberon	20	2.8
St Louis-du-Rhône	897	856.7	Pont l'Abbé	24	2.5
Brest	789	849.8	Port-en-Bessin	15	2.3
Nice	758	734.0	Audierne	22	2.1
Villefranche	358	6,144.9	St Valéry-en-Caux	13	2.1
St Malo-St Servan	1,396	726.8	Abbeville	3	0.4
Bayonne	516	483.3			
Lorient (inc. Port St Louis and Hennebont)	517	424.9			
Charente }	272	186.5			
Rocheport }	153	139.5			

In the above table subsidiary ports of the principal ports are shown in small type.

established as autonomous ports some years ago, but their independence was suppressed again shortly after. Plans for port improvements are generally undertaken by the state. Up to one half of the



expenditure on port development and upkeep is provided by the government, and the remainder is sustained by local authorities such as Chambers of Commerce. The public equipment of a port is operated as a concession, the titular rights of which are held, as a rule, by a Chamber of Commerce.

The official French navigation returns of port traffic name just over a hundred separate ports engaging in the foreign and coasting trade, some of which are very small. In the following account the ports selected for treatment are those at which, in 1937, more than 250,000 net tons of shipping entered and cleared in the foreign trade. There are twenty-four such ports, with twenty subsidiary shipping points which lie within their jurisdiction. Thirty-eight minor ports which engage in a small foreign traffic are also described very briefly. The twenty-five very small ports, with a trade almost entirely coastwise, are mentioned but not described.

#### NOTE ON TERMS EMPLOYED

##### *Port Descriptions*

In the following account a number of terms are used as far as possible in a restricted sense, so that each term always has the same meaning. Generally speaking the English form of the term is employed, although the French name is frequently retained as a proper name, in order to facilitate identification on a map.

*Roadstead* (Rade). A stretch of water near the coast where there is good holding ground for anchors and some protection from the onset of heavy seas.

*Harbour*. An area of sheltered water or protected anchorage within either natural features or breakwaters; sometimes also a small partially enclosed stretch of water lying within the port, such as a fishing harbour.

*Port*. A general term including harbour, quays, piers, docks, basins, warehouses, etc.

*Dock* (Darse). This term is restricted to a branch of a basin or wet dock, e.g. the branches of the Freycinet wet dock at Dunkirk. A *wet dock* (Bassin à flot) is referred to as such.

*Tidal Basin* (Bassin de Marée). An area of water largely enclosed, but opening directly to tidal water, usually equipped with quays and other facilities and used for landing passengers or cargo.

*Basin* (Bassin). In non-tidal ports applied to partly enclosed stretches of water opening off the harbour and equipped with quays.

*Breakwater* (usually 'Digue'). A solid structure protecting a

harbour or roadstead from heavy seas. As a rule, but not universally, vessels do not lie alongside.

*Mole* (Môle). A short solid structure projecting from the shore and usually sufficiently wide to carry railways and warehouses and to provide quay space.

*Pier*. An open structure projecting from the shore, alongside which ships can berth.

*Jetty* (Jetée). (1) A solid structure similar in function to a pier. (2) In many small ports the jetty serves as a small breakwater enclosing the harbour, and is quayed on the inner side. (3) Entrance jetties: projecting structures which protect the entrance from waves and long-shore drift; usually solid but sometimes open.

*Quay* (Quai). An area devoted to handling cargo, bounded at the water's edge by a wall founded at a sufficient depth to permit of vessels lying alongside (though they may sometimes ground at low water). A quay wall is normally vertical, or nearly so; where a wall is sloping, this is specified.

*Wharf* (Appontement). An open-work structure of piling with restricted surface; often connected with the shore by narrow gangways.

### *Units and conventional signs*

On the plans scales are inserted to show both kilometres and statute miles or metres and feet.

On the plans and in the text the depths of the sea, and of channels, except when otherwise stated, are depths at the level of the lowest tides, i.e. the datum of the French marine charts. The depths of basins and, in some instances, of wet docks are given for particular states of the tide, which are described in the text or in the tables. Where the 'Chart datum' is referred to in connexion with lock entrances, dock gates, wet docks and basins, this datum is the datum of the French charts.

In the detailed plans the conventional signs employed are shown in Fig. 2.

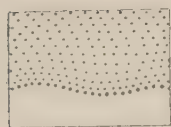
### *Date of information*

Except where otherwise stated, the ports are described as they existed in 1939.

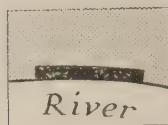
### *Oil refineries*

The oil refineries for which the annual refining capacity is given

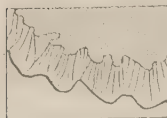




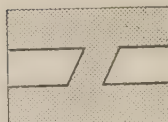
Sandy beach or bank, dry at M.L.W.S. or at the level of the datum of the chart.



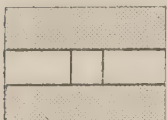
Quays and wharves for sea-going ships in ports which lie along rivers.



Cliffs



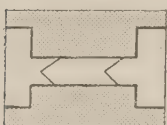
Passage crossed by a fixed bridge.



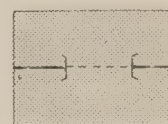
Passage crossed by a movable bridge (swing, bascule, etc.).



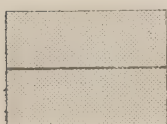
Built up area. The outline has been generalized as a rule except for the larger buildings near the waterside.



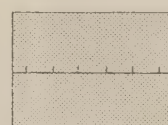
Lock.



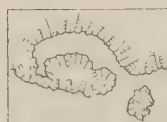
Railway tunnel.



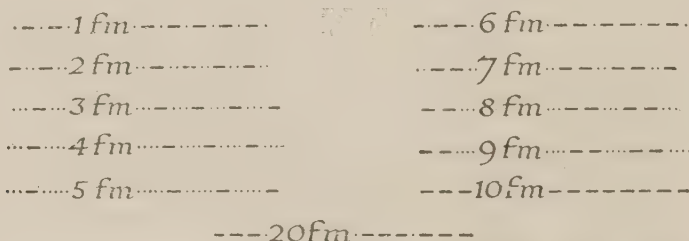
Railway, normal



Railway, narrow gauge (not a town tramway).



Rocky ledges or isolated rocks, dry at M.L.W.S. or at the level of the datum of the chart.



Fathom lines or submarine contours (depth at the level of the lowest tides).

----- Boundary of special dredged areas.

In the detailed plans the railways have been drawn to show all routes, quaysides, etc. covered, but not necessarily the actual number of tracks. The French terms *Gare* (Station) and *Gare Maritime* (Dock or Marine Station) have been employed throughout.

Fig. 2. Conventional signs employed

are the large plants, completely equipped for all processes. These were mostly constructed within the last fifteen years. Refineries for which the annual capacity is not given may be either small plants, not equipped for all the refining processes, or naval installations.

### *Oil Storage*

In the plans the principal oil-storage depots have been shown by the word OIL.



Fig. 3. The Channel ports of France  
The very small ports are not shown (see p. 78).

## DUNKIRK

(See Figs. 4, 5, 61; Plate 1)

### *General Description*

Dunkirk (pop. 31,000) is the fourth largest port in France, by tonnage of shipping, and the main outlet of the rich industrial districts of the north-east, with which it is connected by canal as well as by railway. The port is artificial and is situated on the low and sandy coast of the dreary Flanders plain. It is the only French port on the North Sea, and this fact gives it considerable strategic importance which is reflected in the establishment there of a naval command.

From the seaman's point of view it suffers from its position in the centre of the Flemish Banks which lie parallel to the coast and make access difficult. In fact, Dunkirk can only be approached along the coast from Calais on the west, or through the difficult Zuydecot Pass to the east, and thus navigational difficulties are a real drawback



to the use of the port by large ships. On the other hand, the stretch of water close to the coast and parallel to it, known as Rade de Dunkerque, gives an anchorage that is extensive and protected to some extent by the sandbanks to seaward.

The maximum dimensions admissible to the wet docks are: draught, 10.0 m. (32 ft.) at M.H.W.S., 9.0 m. (29.5 ft.) at M.H.W.N.; beam, 25 m. (82 ft.); length, 161.7 m. (530 ft.), when a ship is being locked, and 185 m. (607 ft.) for turning. As the locks which lead to the inner basins restrict the capacity of the port, the construction of a new and larger entrance has been undertaken (see p. 14). This entrance will consist of a lock 279.8 m. (917 ft.) in length, to the westward of the existing approach channel. The lock itself is now complete and the subsidiary work is well advanced, but the basin inside has not yet been dredged to the requisite depth.

### *Detailed Description*

The Nouvel Avant-port (or outer harbour proper) is usable only in the fairway which leads to the locks. It is formed by two converging jetties, reaching out to a depth of 8.0 m. (26.2 ft.), and forming an entrance 274 m. (899 ft.) wide, which faces north-north-east so as to reduce the amount of swell entering. The east jetty (1,200 m. long) is the longest in France; it consists of reinforced concrete beams on caissons, the structure being open above low water so as to offer the least obstruction to shore currents. The west jetty, 740 m. long, was built on the site of the old west dyke of loose blocks; it is a solid stone structure which provides shelter from westerly and north-westerly gales.

*Tidal Harbour.* The avant-port is the old outer port and is now virtually a section of the tidal port. It is 1,250 m. long, with a depth of 10.9 m. (35.7 ft.) M.H.W.S. and 9.9 m. (32.5 ft.) M.H.W.N. The tidal harbour (Port d'Echouage) is 370 m. long, with depths of 5.9 m. (19.5 ft.) M.H.W.S. and 4.9 m. (16 ft.) M.H.W.N. The area of these two harbours is 7 ha.; of the total quay length of 2,200 m., some 630 m. are available for sea-going vessels. Quai des Monitors, which dries in the south-eastern part, has 200 m. of quay equipped with cranes. The west side of the tidal harbour (Port d'Echouage) is bordered by stone quays, and the east side by stone and wooden quays. A ship-building yard (*Ateliers et Chantiers de France*) is situated on the east side of the old avant-port. In the tidal harbour, on the south, there is a slipway near the Guillain Lock.

*Locks.* There are two locks, which work 2 hr. before and 3 hr.



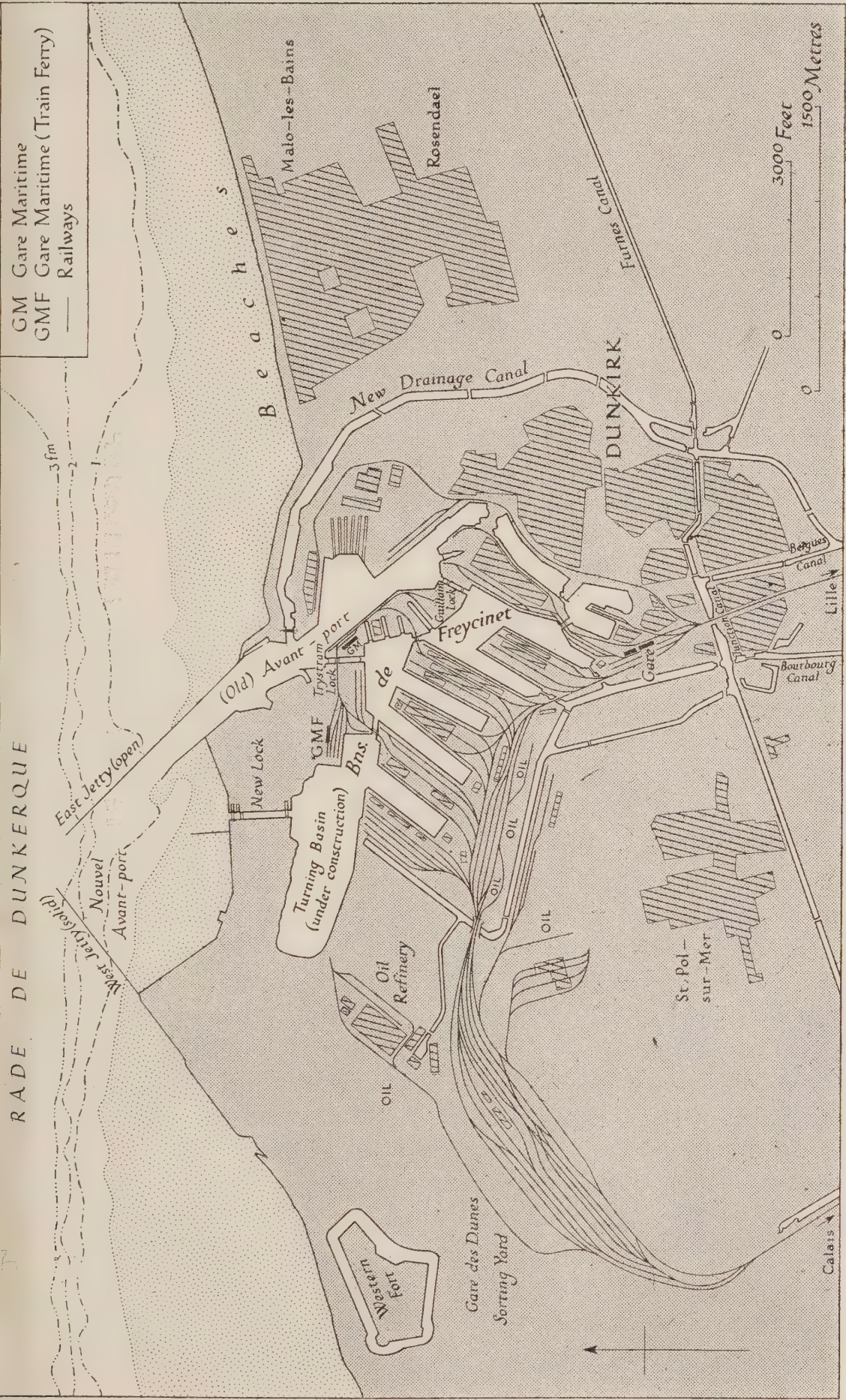


Fig. 4. Dunkirk



after high water. Their dimensions, together with those of the new lock, are as follows:

	Useful length		Useful width		Depth of water over sill			
					M.H.W.S.		M.H.W.N.	
	m.	ft.	m.	ft.	m.	ft.	m.	ft.
Guillain Lock	117.0	383.8	20.1	65.9	7.5	24.5	6.5	21.3
Trystram Lock	161.7	530.0	25.0	82.0	10.9	35.7	9.9	32.5
New Lock	280.0	918.6	40.0	131.2	13.9	45.6	12.9	42.5

The Guillain Lock, built in 1880, leads into no. 1 and no. 2 docks of the Freycinet group, and to three smaller basins—‘Commerce’, ‘Marine’ and ‘Arrière-Port’. It is crossed by two swing bridges for foot and road traffic. The Trystram Lock, built in 1896, leads from the outer harbour to nos. 3, 4 and 5 docks, but it can be used by vessels proceeding to any of the inner basins if the Guillain Lock should fail. The Trystram Lock can be divided into two compartments, 54.9 m. (180 ft.) and 92 m. (301.8 ft.) in length, respectively. A swing bridge carrying a railway line crosses the outer or seaward compartment. The chamber is filled and emptied by means of longitudinal aqueducts situated in the channel walls. The two outer gates are electrically operated while the inner gates, eleven lock-side capstans, sluice gates and bridges are hydraulically worked. The New Lock, intended to connect the inner docks directly with the Nouvel Avant-port, was completed before September 1939, but has never been in use. A channel 150 m. wide has been dredged to connect the lock with the present fairway in the outer harbour. To facilitate the use of this lock a mole, 200 m. long, has been built 50 m. west of its entrance and running seawards. The work of linking the New Lock with the existing inner harbour by means of a channel, 100–200 m. wide, was actually in hand in 1939. The authorities plan to construct a turning basin between the lock and no. 5 dock, with a wharf for tankers on its western side. The Citadelle Lock, condemned in 1926, has been covered over with reinforced concrete for use as an emergency sluice gate for the port.

*Inner Harbour.* The inner harbour is composed of two groups of docks: (1) the Freycinet Group (47 ha. in area), (2) the old harbour. The Freycinet Group comprises five docks, nos. 1–5, separated by four moles, nos. 1–4, together with two turning basins. The old harbour comprises the Bassins de la Marine, de l’Arrière-Port, and du Commerce. Both groups are intercommunicating; they all have

the same water level, but the depths of water vary. Four bridged channels link together the various docks as follows:

Channel connecting:	Passage						Bridges over channel
	Width		Depth				
			M.H.W.S.		M.H.W.N.		
	m.	ft.	m.	ft.	m.	ft.	
Bassin du Commerce, with Bassin de la Marine	13·1	43·0	6·1	20	5·3	17·5	Swing (1) carrying road traffic
Bassin de la Marine, with Freycinet Docks	21·0	68·9	6·4	21	5·4	17·7	Swing (2) carrying road and rail traffic
Nos. 1 and 2 docks, with nos. 3 and 4 docks	20·7	67·9	8·9	29·2	7·9	26·0	Swing (1) carrying road and rail traffic
Nos. 3 and 4 docks, with no. 5 dock and eventu- ally with the New Lock	24·6	80·7	10·9	35·7	9·9	32·5	Swing (2) carrying road and rail for the channel ferry

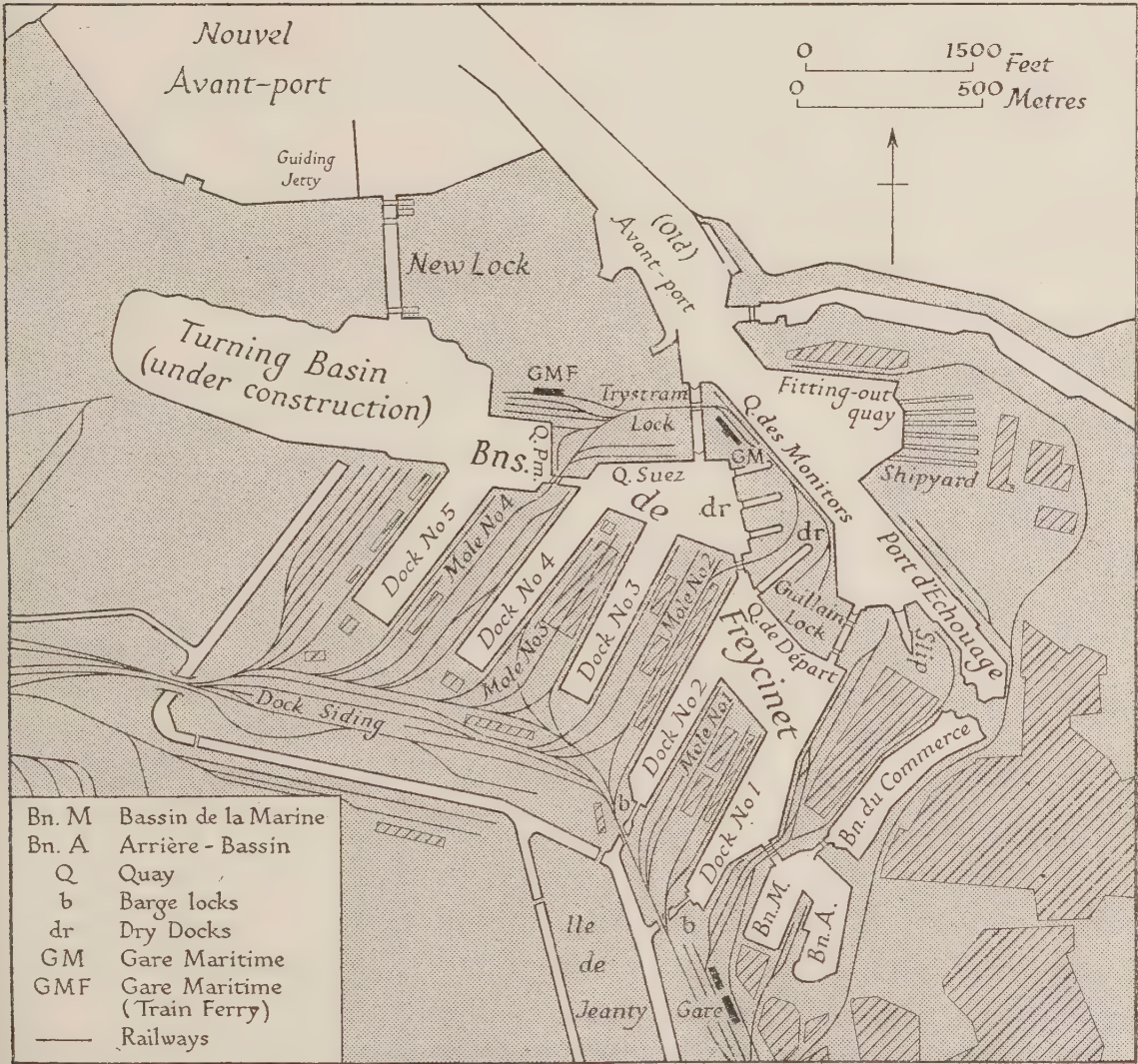


Fig. 5. The dock system at Dunkirk (see also Fig. 61)

Q Pm: Quai de Panama



The port provides sixty-four berths for ocean-going ships, including the special berth for the Dover-Dunkirk train ferry.

	Minimum draught at low water		Length of quays berthable by sea-going ships m.	No. of berths for sea-going ships
	m.	ft.		
Avant-port:				
Quai des Monitors	4·5	14·8	250	2
Quai de Marée Ouest	3·0	10·0	195	1
Quai d'Armement	4·5	14·8	280	Fitting out quay
Freycinet docks:				
Docks nos. 1 and 2	6·65	21·8	2280	19
Quai de Départ	6·65	21·8	240	2
Front of mole 1	6·65	21·8	180	1
Docks nos. 3, 4 and 5	8·65	28·4	3695	27
Fronts of moles 2 and 3	8·65	28·4	230	2
Quai de Suez	8·65	28·4	250	1
	Draught at M.H.W.N.			
Old basins:				
Bassin du Commerce	5·05	16·5	430	5
Bassin de la Marine	5·05	16·5	450	4
Bassin de l'Arrière-Port	5·05	16·5	220	Reserved for naval use

At the end of nos. 1 and 2 docks barge locks provide connexion with the Bourbourg, Bergues and Furnes canals and the barge basin of Ile de Jeanty.

There are only two berths reserved for the petroleum traffic, and incoming tankers frequently have to lie out in the roads and await their turn. The present petroleum quay, in the heart of the harbour, is difficult of access for large tankers, although the new lock will reduce the difficulty. This is part of a general scheme of extension planned for 1939-50, and providing for a bridged passage to the petroleum basin, the petroleum basin itself, quays at the north-eastern corner of the new turning basin, new sheds, etc.

### *Port Facilities*

The equipment of the port in 1939 included 210 cranes and sixteen floating cranes under 10 tons capacity, as well as five automobile cranes and a movable hand crane. There were two large floating cranes, of 20 tons and 40-120 tons capacity. A variety of specialized loading gear dealt with grains, ores, coal and timber.

The shipbuilding yard of *Ateliers et Chantiers de France* is capable of all repair work. This yard has an annual capacity of 50,000 tons,

with six slips up to 164·6 m. (540 ft.) in length. There are four dry docks in the port, of which the largest is 185·5 m. (606·8 ft.) long and 21 m. (68·9 ft.) wide, and capable of accommodating 15,000-ton vessels. There are also a gridiron and a slipway for smaller ships.

### *History*

For a long time the medieval port of Dunkirk had no great commercial importance, and its rise came with the decline of the more inland ports of Bruges and St Omer. Under the counts of Flanders in the thirteenth and fourteenth centuries it was strongly fortified. The many sieges it has undergone testify to its strategic importance. In 1294 it was taken by the French; it was besieged in 1558 and again in 1583, when it fell into the hands of Spain. It was one of the ports selected by Parma for the invasion of England in 1588, although a drawback was its shoalness, whereby even the flotilla could only get to sea on the spring tide. In 1646, besieged on land by Condé and blockaded at sea by Van Tromp, it capitulated to the French only to be captured by the Spaniards. In 1658, when the Commonwealth's strength at sea made it a desirable ally, Mazarin sought Cromwell's help against Spain. Cromwell's price was Dunkirk, now in Spanish hands; for its privateers had taken a heavy toll of English shipping—200 ships of London alone were reported lost—and it was a potential base for invasion by the Royalists. Hence an army of 6,000 and a naval squadron were sent to co-operate with Turenne, and Dunkirk was taken. It remained in English hands for only 4 years, for in 1662 Charles II sold it back to Louis XIV for 5 million livres. Its fortifications were rebuilt by Vauban and it became the principal privateering port. Jean Bart, the most famous of the privateers, operated from Dunkirk. The depredations of the privateers led to an attempt on the place by English forces in 1694, but the attack failed. A second attempt, using explosive ships and smoke vessels backed by a squadron, was made in the following year, but again without success. Blockade failed to stop the depredations, and between 1688 and 1697 the three corsair ports—Dunkirk, St Malo and Dieppe—were reputed to have taken prizes to the value of 22 million livres.

During the War of the Spanish Succession, English convoys in the North Sea and Channel were again fiercely attacked by the corsair squadrons from Dunkirk. In 1708 an invasion of Scotland was set on foot, under Forbin. The watching squadron under Byng having been driven into port by bad weather, Forbin escaped and reached



the Firth of Forth, but he was hotly chased and overtaken, and his attempt failed. The Treaty of Utrecht imposed on France the destruction of the port works and forts, and the closing of the entrance by a dam. These conditions were never fully carried out and, when a new war broke out in 1744, Dunkirk was once more in working order, and an invasion attempt was launched from it without a declaration of war, but with no success. At the peace in 1748 the French again undertook to demolish the port, but did not do so, and it was a base of operations for medium forces in the next war. In 1759 an expedition under Thurot sailed to co-operate with the Brest fleet in the invasion scheme that was broken by Hawke's victory at Quiberon, and Thurot succeeded only in returning safely to his base.

In the War of American Independence Dunkirk played no great part, but it was still a commerce-destroying port, and one of the first operations in the French Revolutionary war was the despatch of a small British army under the Duke of York to act with the Hanoverians and Hessians in Flanders, with the capture of Dunkirk as its principal object. The allied defeat at Hondschoote (8 September 1793) frustrated the attempt. In the Napoleonic period Dunkirk was one of the bases for the projected invasion of England.

The commercial importance of Dunkirk had been limited in the eighteenth century, but its trade was growing at the eve of the Revolution, and after 1815 improved jetties and quays were constructed. In 1845 the old stranding basin was converted into the Commerce wet dock. The establishment in 1848 of a railway connexion to the northern coalfield gave an impetus to expansion, and in 1850, 4,000 ships entered and cleared. After the construction of a new wet dock (no. 1 dock) and the Guillaum Lock, cargo traffic grew, amounting to 0.88 million tons in 1868; the war of 1870 drew further attention to the strategic and commercial importance of the port, and in 1873, 6,400 ships entered and cleared with 1.31 million tons of cargo. Thereafter the trade of Dunkirk steadily expanded.

During the war of 1914-18, the port's position gave it great importance, for it lay on the flank of German destroyers leaving the Belgian coast to attack the Dover barrage, and British and French forces were stationed in Dunkirk to defend the Channel, and to protect the left flank of the allied line where it rested on the sea. Several stirring actions were fought by these ships who hurriedly left harbour to interrupt the retreating raiders. The Germans, recognizing the importance of the port, shelled the town from a point 38 km. away on the Belgian coast and Dunkirk bore gallantly many bombard-

ments. In recognition of the bravery of its citizens, the town of Dunkirk was presented with the British D.S.C. by the Admiral Commanding the Dover Patrol on behalf of H.M. the King, and with the Légion d'Honneur by the French authorities. After 1919 a considerable scheme of improvements was carried out, including the construction of the new outer harbour (Nouvel Avant-port) and deep-water entrance, and a new canal east of the town to provide for inland waterway drainage. Of the new entrance lock giving access to the new no. 6 dock, turning basin and petroleum basin, only the lock has been completed. No work has been done on the projected embarkation mole in the Nouvel Avant-port to deal with passengers from ships which call in passing. Further projected works include a large dry dock and the necessary step of segregating the considerable oil trade of the port.

In the present war the port for some time continued its normal function of an advanced French naval base, but when the German attack became too strong to be resisted, the Allied armies withdrew to the town, and holding a perimeter line on the canals, were evacuated from it and the beaches to the eastward. During the evacuation the town and port suffered very heavily both from shelling and bombing, and large areas were destroyed. Many ships, large and small, were wrecked in the harbour, and finally the British sank four concrete blockships in the approach channel, which closed the port to any vessel larger than a destroyer. At the time of writing the Germans had not done more than clear up the worst of the damage, and the port is badly crippled. Nevertheless, it is one of the centres of preparation for invasion, and several hundred barges were collected there in September 1940, where they were bombed by the R.A.F.

It is clear, therefore, that extensive reconstruction work will be necessary after the war, but there is little doubt that Dunkirk will resume its importance, both commercial and strategic, and it seems probable that the policy of developing the port will be continued.

### *Trade*

#### *Cargo movements, 1937 (thousands of tons)*

Foreign trade: Imports	2,995·8
Exports	1,032·2
Total	4,028·0
Coastwise trade (total)	513·9
Total sea-borne trade	4,541·9
Total foreign trade 1938 (provisional figures)	4,244·6



In 1937 Dunkirk was the fourth French port for aggregate cargo traffic, coming after Rouen, Marseilles and Havre, and was second to Marseilles for export tonnage. Of the import of fuels, coal forms a small proportion, owing to the proximity of the northern coalfield, but the traffic in petroleum and its refined products represents about 25 % of the total import, and amounts to over 1 million tons in some years. Ores and metals, together with raw materials for heavy chemical industries, enter the port for the Lille district and the east. Textile materials provide a large tonnage; while cotton and jute are important, wool is the largest item in this group. Wool destined for Elbeuf, Reims and even for Mazamet in the south, as well as for the neighbouring textile centres, passes through Dunkirk, making it the chief French port for the import of wool. In this trade it has suffered from the competition of Antwerp despite the Franco-Belgian agreement of 1937 which aimed at equalizing the competitive situation.

The export trade is considerable, partly owing to the proximity of the northern coalfield but also from connexions with eastern France. Port and railway authorities have made great efforts to attract the trade of Lorraine from Antwerp, and the French railways keep the Dunkirk freight rates as low as those operating to Antwerp. Though the greater part of the Lorraine export still passes through Antwerp, iron and steel exports from Dunkirk amounted in 1938, for example, to 254,000 tons, and metal manufactures to 102,000 tons. Of the remaining variety of exports, refined petroleum products is the largest item.

Seventy-one steamship lines serve the port, divided among seventeen French companies with thirty-one lines and thirty-two foreign companies with forty lines. These services accounted for 31 % of the imports and 53 % of the exports. The French colonies take a large share of the trade of Dunkirk—about one-quarter of the exports are destined for north and west Africa. There is comparatively little long-distance passenger traffic.

The tonnage of ships using the port trebled during 1910–35. Having one of the most active industrial regions in France as an immediate hinterland, it enjoys certain positive advantages over other French ports: maritime freight rates for cotton, for example, are the same for Havre or Dunkirk, so that by using Dunkirk, Lille saves the cost of a 240 km. rail haul. The competition of Antwerp is a factor which must constantly be taken into account, however. The following table gives the comparative distances by rail from various

big industrial towns in the north of France to Dunkirk and to Antwerp.

From	Distances, in km., to	
	Dunkirk	Antwerp
Armentières	66	149
Lille	85	130
Roubaix	90	120
Tourcoing	93	118
Cambrai	148	202
Valenciennes	133	140

### *Industries*

The oil refinery at St Pol, to the west of the docks, has an annual capacity of 400,000 tons. Other industries include saw-milling, oil-seed milling, the manufacture of hemp, jute, and other textiles, and chicory grinding. Owing to the lack of industries, the town remains small and cramped between the fortifications and the port. The small industrial suburb of St Pol-sur-Mer, on the site of a British aerodrome of the last war, is expanding. The shipbuilding industry has mainly subsisted on government orders.

### *Communications*

*Canals.* The canals serving Dunkirk are small compared with those in Belgium and Holland. The port is, nevertheless, linked by several canals to the main system of northern France, along which passes a very large volume of trade with the interior. Near the wet docks is the barge port serving the canals of Bourbourg, Bergues and Furnes, and possessing extensive storage grounds. These canals all admit the Flemish barge or *péniche* of 300 tons capacity. The Ile de Jeanty canal acts as a barge dock, and as a link for the canal system (Plate 84). Of the total waterway traffic with Dunkirk inwards and outwards in 1935, the Bourbourg Canal and River Aa handled 78 %, the Bergues Canal 18 % and the Furnes Canal 4 %; for all three the outward traffic from Dunkirk amounted to about 60 %, and the inward to 40 %. These canals also serve as outlets for the many waterways, large and small, which drain the 60,000 ha. of the Wateringues district. The drainage system includes a series of locks and siphons, many of them very old, culminating in the locks at Dunkirk and Gravelines. An outlet of the Wateringues drainage was constructed to the east of the port in 1929. Dunkirk cannot extend to the east, and each successive westward extension of the port involves a shifting of the lock controlling this drainage network. The demolition of the



old fortifications to the south and the west of the port has released some 21 ha. for quays, storage ground and factory sites.

*Railways.* The railway communications of Dunkirk are good, and the French government as a matter of policy in order to assist the port has granted preferential tariffs, which have been an important factor in securing trade for Dunkirk. The most important railway runs inland to Hazebrouck, where it divides, one branch serving Lille and connecting thence with Belgium, Germany and Lorraine, the other running southwards across the coalfield and so to Amiens and Paris.

The 12.9 km. of quays are served with a total of 246 km. of lines and sidings, laid as follows (1939):

	km.
Quays on the eastern side of the Tidal Harbour, Bassins du Commerce, de la Marine, de l'Arrière-Port ...	13.9
Wet docks ... ..	69.1
Sidings alongside Freycinet Group ... ..	21.6
Sidings at St Pol-sur-Mer (Gare des Dunes) ... ..	92.2
Others ... ..	50.1
Total	246.9

The average number of trucks handled daily is about 1,500, but at times the maximum exceeds 3,000. Trucks are handled on all quays, removed to the port siding, and then run to the Gare des Dunes, a large marshalling yard behind the port. In recent years there has been a tendency for more goods to move by canal and road than by rail, compared with the period before 1931.

*Movement of Trade, inwards and outwards together*

	1929		1935	
	thousands of tons	%	thousands of tons	%
Railway	3,487	71	2,166	51
Water	949	18	926	21
Various and into stock	604	11	1,270	28
Total	5,040	100	4,362	100

Dunkirk is the French terminal of one of the cross-channel routes, and also of the new train-ferry service from Dover.

There is a certain amount of fishing carried on from the port. In 1935 the seventy-five boats operating from Dunkirk landed 809,400 kg. of fish and crustacea.





Plate 1. Dunkirk (looking seawards)

Since this photograph was taken the old canal around the lighthouse has been filled in, while the New Lock and a large turning basin, opening westwards from the most westerly dock shown, have been nearly completed. The Trystram Lock, admitting to the Freycinet dock system, lies to the right of the lighthouse; across the tidal harbour are the shipbuilding yard and floating dock (this dock was removed after 1939). In the foreground are the older docks, and to the left the town station and the Canal de l'Île de Jeanty, or barge port, in which many barges are moored. (For maps see pp. 13, 15.)





Plate 2. Calais (looking north-east)

A view from the Petit Paradis basin across the avant-port to the Gare Maritime, alongside which a cross-Channel packet is moored. The half-tide landings of the Gare Maritime quay have now been filled in. (For map see p. 24.)



Plate 3. Boulogne (looking north-west)

In the immediate foreground is part of the sluicing basin, separated from the arrière-port by the Pont de la Liane; on the left is the town station. Beyond the arrière-port and the Pont Marguet is the Port de Marée, opening from the entrance channel. At the outer end of the Port de Marée is the Gare Maritime. To the left is the Bassin à Flot, with the long Fish Market on the nearer side. Outside this lock lies the Bassin Loubet. Part of the Digue Carnot can be seen and three liners anchored in the roadstead. This breakwater has since been extended some distance northwards. (See Plate 38, Vol. III, for view of the fish quay. For maps see pp. 29, 30.)



## CALAIS

(See Fig. 6; Plate 2)

### *General Description*

Calais (pop. 67,000) is the nearest of the French ports to England, lying 34 km. from Dover.

Off Calais a large bank lies parallel to the shore, and is separated from it by a 'ditch', which provides a stretch of water relatively sheltered from north to west winds. This depression is 1,100 m. wide and 10–15 m. (32·8–49·0 ft.) deep at low water. The Rade de Calais, lying between Les Ridens de Calais and Les Ridens de la Rade, is exposed to onshore winds, and is therefore used only by vessels awaiting entrance to the port. The inner channel enters between the East jetty (414 m. long) and the West jetty (330 m. long), the heads of which are 130 m. apart. These two converging jetties are vertically faced moles with framed timber superstructures. The channel is dredged to 5 m. (16·4 ft.), with 6 m. (19·7 ft.) at the jetty heads. The harbour needs very considerable dredging each year.

The tidal range is 7·2 m. (23·5 ft.) at springs and 3·5 m. (11·5 ft.) at neaps. The tidal currents run parallel to the coast, the flood running east and attaining a maximum of  $3\frac{1}{2}$  knots. The entry of vessels to the port is best timed to take place 3 hr. before or 3 hr. after high water.

### *Detailed Description*

The port consists principally of an avant-port and two wet docks—the Carnot basin, covering 12 ha., and the west basin, covering 4·5 ha. Vessels up to a length of 173 m. (567·6 ft.) can be accommodated; vessels of this size can be turned round in the northern part of the Carnot basin, but if they are berthed in the west basin they must be towed out stern first into the avant-port for turning. In the channel the maximum draughts which are normally permitted are: 10·1 m. (33 ft.) at M.H.W.N., and 11·5 m. (37·7 ft.) at M.H.W.S. Access to the Carnot basin is by means of two parallel locks. The depth of water on the sill of the south lock is 7·45 m. (24·2 ft.) at M.H.W.N. and 8·75 m. (28·7 ft.) at M.H.W.S.; the width of the lock is 21 m. (68·9 ft.) and the effective length 135 m. (442·9 ft.), although at high water vessels up to 173 m. (567·6 ft.) can be passed through it. The north lock is 14 m. (45·9 ft.) wide. Both locks are divisible into two. Access to the smaller west basin is by a single dock gate 17 m.



(55.7 ft.) wide, with a depth on the sill of 7.6 m. (25 ft.) at M.H.W.N. and 8.9 m. (29.2 ft.) at M.H.W.S.

The avant-port contains two important quays: the Gare Maritime in the north-east and the Paul Devot in the south-west. The Gare Maritime quay is 560 m. long; of the four berths by the station, one of 135 m. (443 ft.) is used by the Dover ferry boat, and three are for

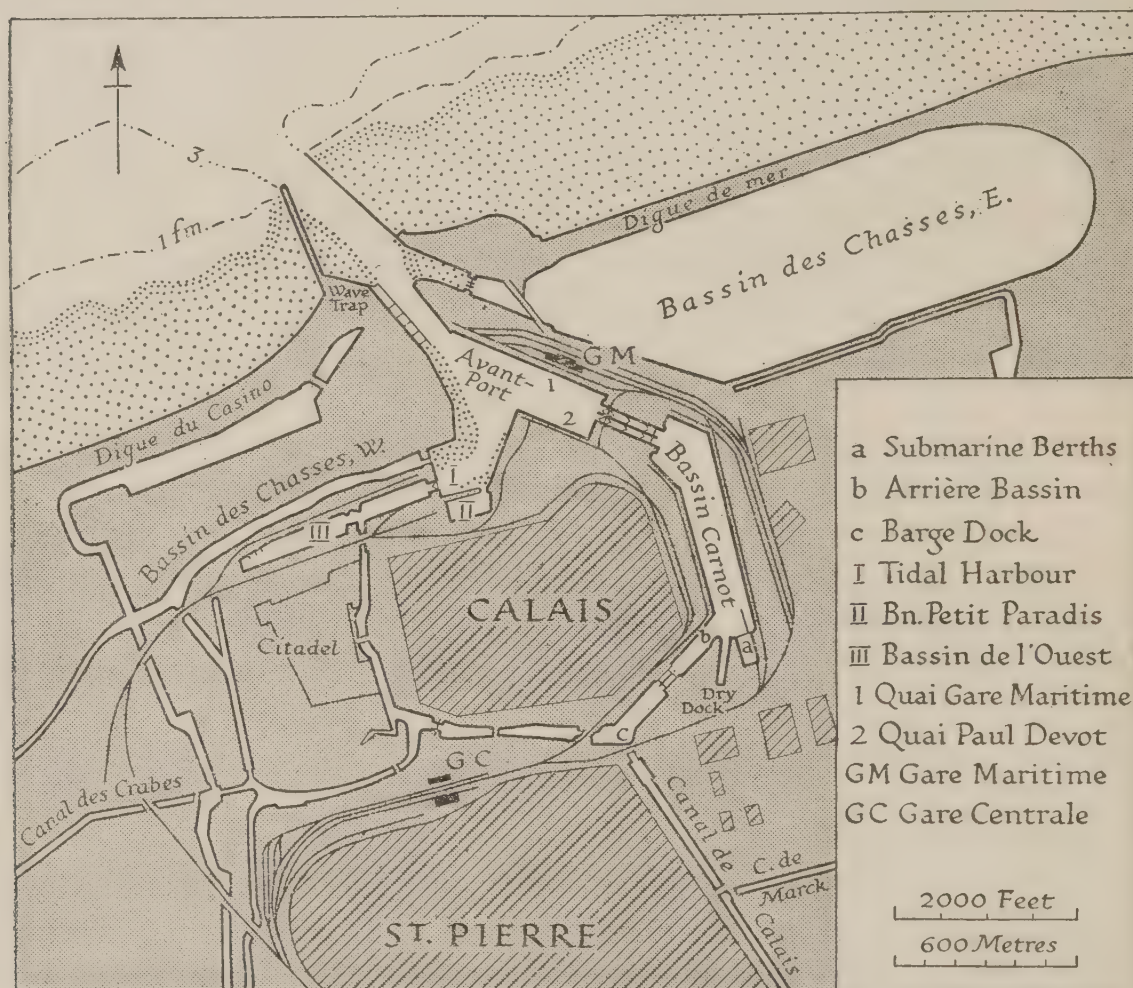


Fig. 6. Calais

The train ferry berth lies at the extreme south-eastern corner of the Bassin Carnot, near the submarine berths.

mooring. The station has recently been rebuilt and can accommodate up to ten waiting trains. The western part of the avant-port is used for stranding boats, and the small Petit Paradis basin is reserved for fishing vessels. The two wet docks handle the greater part of the cargo traffic. Accommodation for sea-going vessels may be summarized as shown in the table on p. 25.

There are 4,254 m. of quays, of which nearly 2,000 m. are accessible to vessels drawing more than 7 m. (22.9 ft.). Warehouses cover

36,000 sq. m. and have a capacity of 24,000 tons, while the 153,000 sq. m. of storage grounds have a capacity of 110,000 tons. The port of Calais possesses a considerable number of warehouses and sheds for the storage of nitrate of soda, timber and perishable goods. The train-ferry berth in the south-east corner of the Carnot basin, built for the British army, was put into commercial service in 1930. Miscellaneous facilities include two oil-receiving depots, and cable ships for handling the submarine cables which are manufactured at Calais. The south or inner end of the Carnot basin is known as the Arrière basin. From it two parallel barge locks lead into a basin which forms the inland waterway port and is the terminus of the *Canal de Calais à St Omer*. A barge lock in the west basin also communicates with this canal basin.

	Low-water depths				Berths	Draught	
	Equinoctial springs		Ordinary springs			m.	ft.
	m.	ft.	m.	ft.			
Avant-port: Quai de la Gare Mari- time	4.65	15.2	5.22	16.2	12, of which 4 are at the Gare Maritime 2	4.65	15.2
Quai Paul Devot	7.15	23.4	7.72	25.3		7.15	23.4
	Depth M.H.W.N.						
Bassin Carnot; maximum length admitted 173 m. (567.6 ft.)	7.45	24.4			14 1	7.45 4.95	24.4 16.2
Bassin Ouest; maximum length admitted 75 m. (246 ft.)	3.75- 7.6	11.3- 24.9			2 2 6	3.75 4.95 7.67	11.3 16.2 24.9

### Port Facilities

The avant-port deep-water quays and the two basins are equipped with sixty-one cranes of under 10 tons capacity, and six transporters, while there are three floating cranes of under 10 tons, and one 40-ton crane. Most of the lifting equipment is of a modern type. The dry dock at the south end of the Carnot basin is 150.8 m. (494.7 ft.) long on the bottom, with an entrance 21 m. (68.9 ft.) wide, and with a sill 1.78 m. (5.8 ft.) below datum. There is also a grid-iron.



### *History*

The old town and citadel stand on a dune island, completely surrounded by the basins and canals of the port. The fine sand on which Calais is founded hinders water filtration, creating unfavourable foundations for buildings. All the port works are founded on sand, and it is necessary to go at least 20 m. below chart zero to find Flanders clay and 100–150 m. to reach chalk. In Roman times the present coast was submerged, and the existing shore was gradually built up by deposition. A lagoon formed behind the coastal dunes, and in the seventh century Calais was established on the banks of a channel leading from this lagoon to the sea.

Lying near the shortest sea passage between England and France, it has been a port with a peculiar importance for nearly a thousand years. Great prosperity was experienced during much of the period of English rule (1347–1555), especially after Edward III established it as a wool staple port. Calais was the last English possession on the mainland of France, for it was retained until 1558.

As the channel leading to the harbour tended to move from east to west, there were early attempts to stabilize it by means of jetties. Henry VIII's project for the construction of two jetties was not realized; Vauban built two jetties in 1673, but not long after changes in the shoreline reduced the value of his work. In the eighteenth century Calais experienced considerable activity as a packet station. After the disturbances resulting from the Napoleonic wars, the development of the steamship, and then of the railway, allowed Calais to take advantage of its favourable location. The first regular steamship service began in 1820 with the *Rob Roy* of 90 net tons, and with the opening of the Maritime Station in 1849, the first such station in France, Calais became established as a cross-Channel port. In the early part of the last century de Lisle's plan to prolong the jetties by 250 m., to excavate the dunes basin, and to dredge out a wet dock, was sanctioned. The period 1875–81 saw the adoption of the Freycinet plan to dredge an avant-port to 3.5 m. below datum, to construct a wet dock covering 12 ha. (the Carnot basin) and a new eastern sluicing basin, and to rebuild the East jetty. Early in this century the western part of the port was improved, and the west basin deepened. During the war of 1914–18 the port equipment was improved to meet the needs of the British army. When Germany invaded France in the summer of 1940 Calais was defended for several days by a portion of the British Expeditionary Force against

greatly superior German forces, thus gaining an invaluable breathing space for the main British force retiring on Dunkirk. Considerable damage was done to the port.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	652.9
Exports	29.0
Total	681.9
Coastwise trade (total)	59.7
Total sea-borne trade	741.6
Total foreign trade 1938 (provisional figures)	762.7

The cargo traffic is small, and much below that of Boulogne. Calais is the natural outlet of the St Omer region, but is less closely related to the northern coalfield than Dunkirk. The principal imports are timber, including pit-props, and heavy produce needing powerful cranes, such as manganese ore, pitch, phosphates, nitrates, etc. Calais is conveniently planned for such imports, as it has storage space for 60,000 tons. In recent years there has been an import of Cameroon bananas with a return export of straw to the Canary Islands. Exports are very small in amount and include foodstuffs such as poultry, wine and dairy produce, yarns, lace and tulle. There is a coastwise traffic in grain, sugar beet, fertilizers and building stone.

Built on reclaimed marsh behind the dunes is the modern industrial town, which has grown up as a result of favourable canal and railway communications, themselves dependent on cross-Channel traffic and the main railway line to Paris. Industrial Calais, the suburb of St Pierre, is chiefly engaged in machine lace making, for which it is the chief centre in France. Tulle (the foundation of much machine lace) is also manufactured, as well as embroidery. An important English-owned artificial silk works was established about 1930. The export of lace is the mainstay of industrial Calais, and prosperity varies with the state of the U.S.A. market.

### *Communications*

There are 45 km. of railway in the port, connected at three points with the northern section of the state railway system. Trains of 40-ton hopper wagons carrying 800 tons are employed in transporting minerals to steel works on the northern coalfield. There is a canal connexion with northern France and Belgium for 280-ton barges,



traction to St Omer being effected by Diesel motors on the bank. Of the goods moving in both directions between Calais and its hinterland, the proportion carried by rail has declined considerably in recent years, and the proportion carried by canal has shown a corresponding rise.

*Inland Movement of Goods at Calais, Inwards and Outwards  
(thousands of tons)*

	By rail		By canal	
		%		%
1931	616	82·5	131	17·5
1932	444	66	226	34
1933	623	69	285	31
1934	497	57	381	43
1935	397	55	327	44

The Anglo-French trade is the main reason for the existence of the port. The principal service in peace-time consisted of two daily passenger and two daily cargo services to Dover, daily or twice weekly train-ferry services to Harwich, and services for the transport of motor cars in summer.

## BOULOGNE

(See Figs. 7, 8, 62; Plate 3)

### *General Description*

The packet station, fishing port, and seaside resort of Boulogne (pop. 52,000) is situated at the mouth of the little river Liane, which enters the sea between limestone cliffs about 4 km. north of Cap d'Alprech. It is the premier French fishing port and is third in order of importance as a passenger port, with transatlantic as well as cross-Channel connexions.

The approach to Boulogne is sheltered, save from north-westerly winds, and even from this direction the waves are broken by the Bassure de Baas bank. Rade de Carnot, the outer harbour, is protected from winds between south and west by the Digue Carnot, 2,110 m. in length, and from north and west winds by the Digue Nord. This breakwater extends westwards from Pointe de la Crèche, and in 1939 was being lengthened by 640 m. East of the Digue Carnot is an area which, with the approach channel, was being dredged in 1939 to 9·4 m. (30·4 ft.), and was reserved for large vessels. Access to the Carnot roadstead is easy, as the Bassure de Baas bank

outside has a break with a depth of more than 11 m. (36·1 ft.) and currents are not strong.

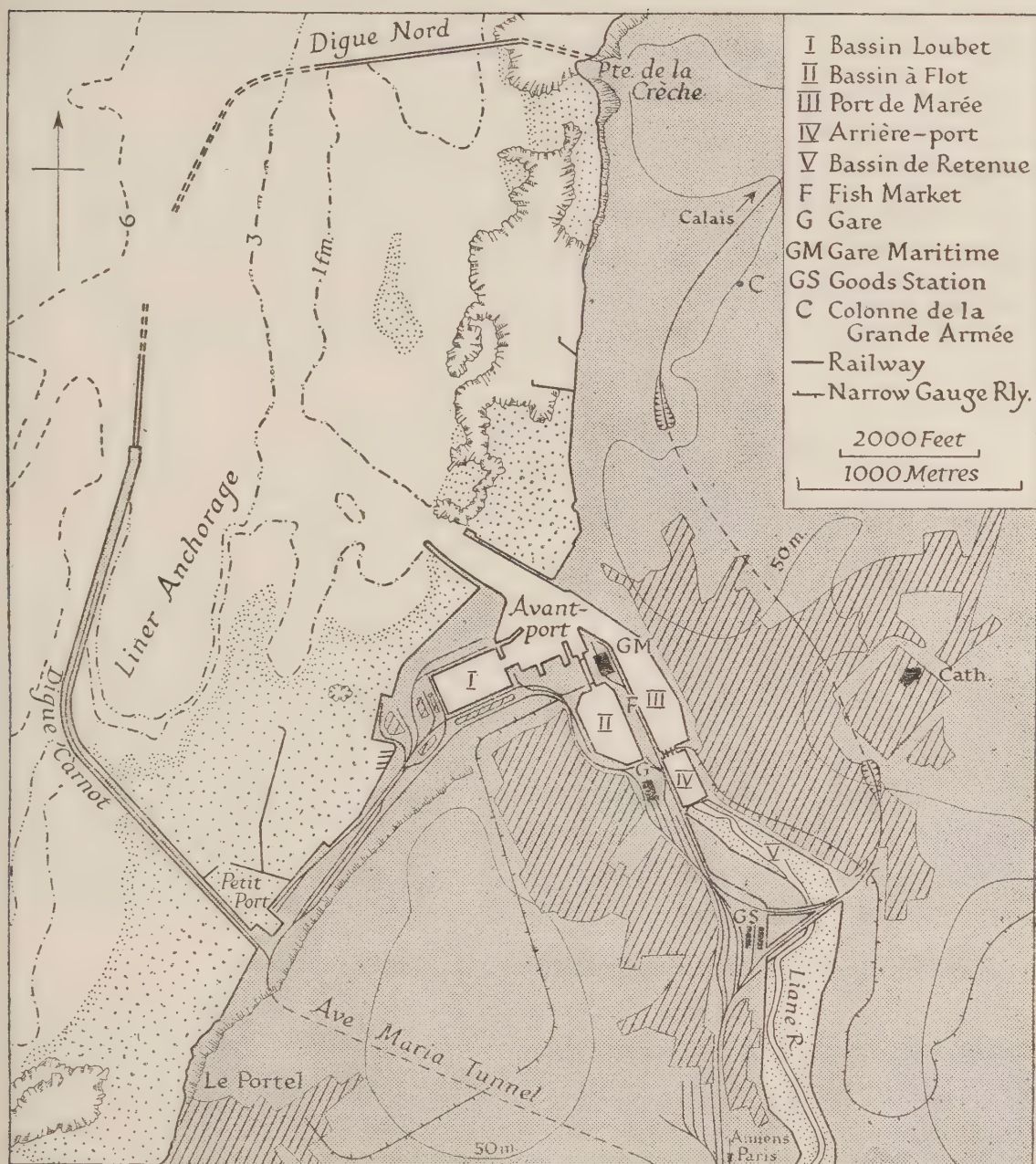


Fig. 7. Rade de Carnot and Port of Boulogne (see also Fig. 62)

The 50 m. contour is shown.

### Detailed Description

The port of Boulogne is best considered as consisting of two main parts, the liner anchorage and the inner port.

**Liner anchorage.** The 'Mouillage des Transatlantiques' provides anchorage for three large mail liners. The maximum draught for access to this roadstead is 15·8 m. (51·8 ft.) at H.W.L.N. It has been used by vessels as large as the Norddeutscher Lloyd *Columbus*, 35,000



tons gross, 228 m. long and drawing 10·1 m. (33 ft.). Passengers and baggage are landed by tenders, which berth in the Port de Marée of the inner port. In the southern corner of the roadstead, at the root of the Digue Carnot, is the Petit Port, a small harbour enclosed by two moles, which dries at low water.

*Inner Port or Boulogne proper.* The entrance channel to the inner port is 450 m. long; it is 110 m. wide between the two jetties, and 70 m. (229·6 ft.) wide farther in, and has a minimum depth of 5·0 m. (16·5 ft.). There are four parts of this harbour usable by sea-going ships: the avant-port, the Loubet Basin and Port de Marée, all tidal, and the Bassin à Flot (wet dock). The maximum draught for access,

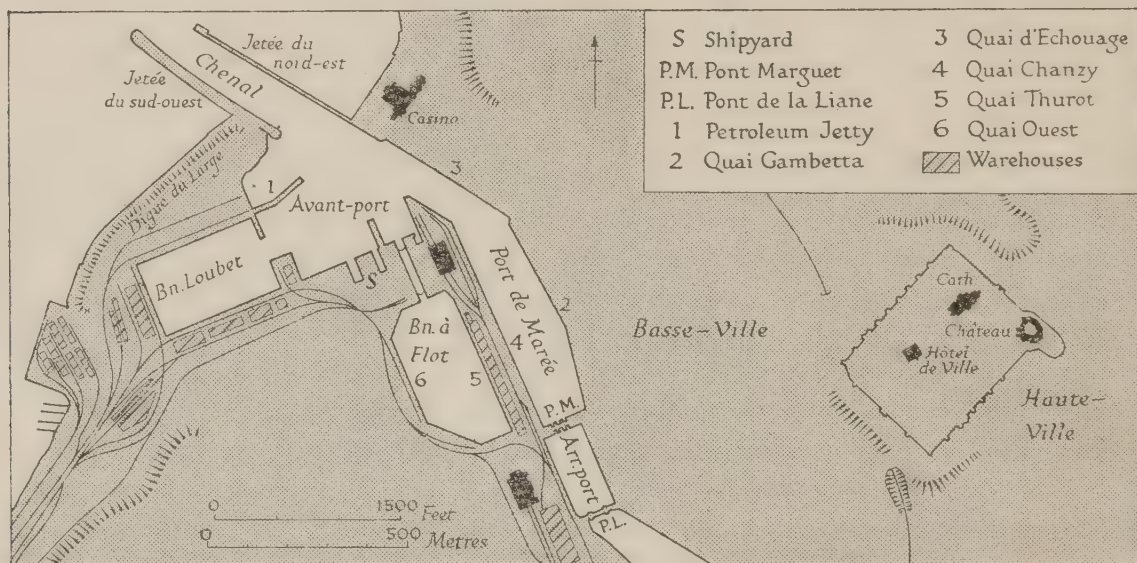


Fig. 8. Boulogne. The Petroleum Jetty is probably an openwork structure

to the tidal sections at M.L.W.N. is 10·3 m. (33·7 ft.); entrance to the wet dock from the avant-port is governed by a lock, which has 5·5 m. (18 ft.) on the sill at M.L.W.N.; the length of this lock is 100 m. (328 ft.), and the width 21 m. (69 ft.). The following are the limits upon turning in the various sections of the port:

Avant-port	Vessels up to 167 m. (548 ft.)
Port de Marée	Congestion usually prevents turning of vessels longer than 80 m. (262·5 ft.)
Bassin Loubet	Vessels up to 170 m. (557·7 ft.)
Bassin à Flot	Congestion usually prevents turning of vessels longer than 150 m. (492 ft.). Vessels using the entrance lock must not exceed a length of 90 m. (295 ft.) and a beam of 19 m. (62 ft.)

The minimum depth of water available in tidal sections of the port is 4 m. (13·1 ft.) and the port can thus be utilized at all states of the

tide by vessels like the cross-Channel packet steamers. The avant-port dries at 2.4 m. (7.9 ft.) along the north-east quay, which is thus known as Quai d'Echouage. There are wave-traps on the south-eastern side, and a new pier for tankers on the western side. The arrière-port is separated from the Port de Marée by the Marguet dam, the sill of which is 3.3 m. (10.8 ft.) above datum, and is thus accessible only to very small craft. Above the arrière-port, the lowest reach of the river Liane, called the Bassin de Retenue, is used for the retention of sluicing water. Dredging is essential in the port and buckets are better than suction dredgers as a fine silt has to be lifted. The large barge-loading bucket dredger *Pas-de-Calais II*, built in 1933, is able to dredge 23 m. (75 ft.) below water level, and can cope with the proposed depth of 13 m. (42.6 ft.) below chart datum for the approach channel.

The inner port provides 33 berths for sea-going ships:

	Area ha.	Principal quays	Length m.	Berths	Depth		Use
					m.	ft.	
Avant-port	12	Eperon (two faces)	270	12	M.L.W.S.		Cross-Channel
		Petroleum Pier (two faces)	160		5.0	16.5	
Port de Marée	8	Chanzy Gambetta Excursionnistes	1,039				Liner tenders, fishing
Bassin Loubet	6	Nord	955	6	6.0	19.7	General trade, heavy goods and coal
		Ouest		3	5.0	16.5	
		Sud		2	8.7	28.5	
Bassin à Flot	7	Thurot Louvre Ouest	950	10	M.H.W.S.		Fishing, and general trade
					6.5	21.3	

Quai d'Echouage is a stranding quay, 354 m. long. The total length of quays is 3,737 m.

### Port Facilities

The port possessed in 1939 some fifty-seven cranes, varying in capacity from 1.5 to 40 tons. Warehouse space is sufficient to accommodate 60,000 tons of merchandise, and the quays can hold in addition a further 190,000 tons. Repairing apparatus at Boulogne included a floating dock, capable of taking vessels up to 1,300 tons, situated within the Bassin à Flot, and two small slipways on the edge of the avant-port, for the use of 1,000-ton and 1,500-ton vessels



respectively. There were also three gridirons, one fairly large (127 m. (416 ft.) long) to take vessels up to 1,500 tons, the other two for fishing vessels.

### *History*

The town of Boulogne falls naturally into two parts. The 'ville basse' is cramped in the bottom of the Liane valley; it contains the port, the business centre, and the residential quarters of Capécure and Bréquerecque. The 'ville haute', on the limestone hill to the east, is still surrounded by its medieval fortifications; it contains the administrative centre, the cathedral and the thirteenth-century castle. The original cathedral was destroyed during the Revolution, and the present structure dates only from the mid-nineteenth century. The casino and beaches, north of the harbour, are probably as well known to English visitors as to French holiday makers.

It was from Boulogne that the Romans embarked for their invasion of Britain, but the Normans, into whose hands it fell in A.D. 882, made little use of it. The dukes of Burgundy acquired it in 1430, and Louis XI captured it in 1477. Henry VIII of England took it in 1544, but it was finally restored to the French in 1550. The first port works were built during the sixteenth century. These were two jetties to protect the Liane estuary; they formed the small basin of Petit Paradis, a site now occupied by the Quai Gambetta. The first half of the seventeenth century saw great prosperity; Boulogne was a base for privateers and flourished greatly on the proceeds of their depredations. There was, moreover, considerable trade with England, and the *Compagnie des Indes* had a depot here. This prosperity, however, was greatly disturbed by the wars of the eighteenth century. In 1798 the port was chosen as a base for operations against England, and in 1801 Napoleon mustered there his army of invasion, comprising 180,000 men and 2,400 vessels. A tall column, surmounted by a bronze statue of Napoleon, stands on the hill north of the town to commemorate this event; it is a prominent object from the sea. As part of the preparation of the port as an invasion base, the Imperial sluicing basin was built in 1800.

After the Revolutionary period the port was neglected, but its fortunes revived with the coming of the railway. Passenger traffic was created by the establishment of the Folkestone packet service in 1843, and in 1847 came the opening of the railway to Amiens. Several port improvements followed, and the Digue Carnot, which had been started in 1789, was eventually completed in 1889; it

provided 53 ha. of sheltered water dredged to depths suitable for the transatlantic liners of the time. During 1902–10, the Loubet basin was constructed. Between 1914 and 1918 Boulogne was the main British army base; it sustained numerous air raids during the last two years of the war. Since 1918 the railway station and quays have been enlarged, and further improvements were authorized in 1930, providing for the lengthening of the Digue Carnot by 525 m., the construction of the north breakwater, 2,000 m. long, and the installation, in the southern part of the surface so protected, of a mole and two docks for transatlantic, cross-Channel and cargo vessels. It is intended eventually to transfer the Gare Maritime to the mole, so that boat trains will be able to pass through the Ave Maria tunnel to the main line and avoid the present crawl between the harbour and town stations. By 1939 more than half the dredging necessary for this scheme, and also the masonry work of the Digue Nord, had been completed; work on the Digue Carnot was well advanced, while a landing stage for oil tankers in the avant-port had been finished (see also pp. 215, 217).

The port has suffered substantial damage during the 1940 operations and in subsequent air raids.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	534·4
Exports	366·1
Total	900·5
Coastwise trade (total)	131·8
Total sea-borne trade	1,032·3
Total foreign trade 1938 (provisional figures)	1,091·3

Among the imports, coal bulks very large; it goes into local domestic and industrial consumption, including the local iron and cement industries. Iron and manganese ores are discharged, mainly for use in the blast furnace at Outreau. There is a small timber import, mainly pit-props destined for the northern coalfield. Among the exports, cement, from nearby works, is an important item. The Boulonnais region, with extensive quarries for sandstone, limestone, chalk and clay, provides the raw material for cement, brick and tile and sanitary-ware manufacture; from a beginning in 1850 the cement industry has grown until it now represents 20 % of French productive capacity. Eleven large works produce a million tons of lime and



cement a year, some of which is exported (in 1934, 80,000 tons abroad, and 121,000 tons coastwise). Other exports include manufactured goods, e.g. motor cars and textiles, mainly from the industrial north, and wine, fruit, vegetables and flowers, mainly from the south.

Boulogne is second to Marseilles among French ports for passenger traffic. In the years 1929-31, 600,000 passengers per annum passed through the Gare Maritime, representing an average of 1,600 a day; the corresponding figures for 1934 and 1935 were 392,000 and 330,000 respectively. Before 1914 there was a considerable emigrant traffic to the Americas, but transatlantic passengers in 1928 numbered only 27,000 (cf. 580,000 cross-Channel passengers), and in 1934 no more than 7,000 (cf. 385,000 cross-Channel).

The fish market, 5,000 sq.m. in area, sells 160-200 million francs worth of fish each year, and the industry was little affected by the trade depression.

Boulogne is the first fishing port of France, and has been called the Grimsby of continental Europe. There were 500 boats in the fishing fleet, totalling 36,000 tons, and more than 4,500 fishermen were employed. In 1930, 65,000 tons of fish were landed; in 1936, 72,000 tons, and in 1937, some 87,000 tons. In addition, there was some import of fish, so that over 100,000 tons were annually despatched by rail (see p. 262). One-tenth of the population are concerned in the industry, for in addition to the coastal fishing, there are the occupations of curing, salting, packing and net making. Much of the trade is in the hands of large trawling firms. The size of the subsidiary industries can be gauged from the fact that 650 tons of ice could be made in a day.

### *Communications*

The port railway lines serving the quays total 27 km.; they are connected with the main Calais-Paris line. The eastern part of the port gains access to the main line by two junctions at Outreau, whilst the Loubet basin and the Digue Carnot are served by a line passing through the Ave Maria tunnel to a junction with the main line just south of Outreau locomotive depot. The cramped situation of the town in the narrow mouth of the Liane valley is further evidenced by the way in which the main line to Calais tunnels underneath the eastern suburbs. Except southwards in the direction of Paris, inland rail communication from Boulogne is relatively poor; the port is connected with the northern industrial region only by two single-track lines (to St Omer and to Arras) and by a longer and more circuitous

double-track route via Calais which, however, involves the steep gradients of Caffiers bank (see p. 256).

## DIEPPE

(See Fig. 9; Plate 4)

### *General Description*

Dieppe (pop. 25,000) resembles Calais in being primarily a cross-Channel port, but it is also a fishing centre of considerable importance.

The roadstead of Dieppe extends for about 5 km. from the entrance channel; it is only slightly protected by Pointe d'Ailly, and has little shelter from winds. The entrance leads from the north-north-west to the jetty heads, which are 100 m. apart. These two converging jetties delimit the area in which vessels may be turned, which comprises 11 ha. with a depth of 4 m. (13.1 ft.) below chart datum. At 420 m. from the entrance the channel curves south-westwards; the curve is 400 m. long and 75 m. wide. The maximum draught admitting to the port is 11.0 m. (36 ft.) at M.H.W.S., 9.75 m. (31.8 ft.) at M.H.W.N and 8.4 m. (27.5 ft.) at low water. This considerable depth of water is a great asset, for it enables the cross-Channel steamers, for example, to enter and leave at any state of the tide, although shortly before 1939 the channel was allowed to slit to 2.1 m. (7 ft.) at low water.

Apart from fishing vessels, those parts of the port accessible to ocean-going vessels can accommodate about twenty-five ships at the 2,047 m. of berthable quays. The maximum dimensions of vessels which can enter the half-tide basin and wet dock are 140 m. (459 ft.) length and 17.25 m. (56.6 ft.) beam. The half-tide basin can take 10,000-ton ships. Entry to the Bassin Duquesne is limited to vessels up to 75 m. (246 ft.) length and 13 m. (42.6 ft.) beam.

### *Detailed Description*

The port comprises the Avant-port, Arrière-port, Duquesne basin, Darse de Pêche, Bassin du Canada and Bassin de Paris. The outer harbour (avant-port) is reached directly from the entrance channel; it is used by the Newhaven steamers and by trawlers. It is prolonged by the fishing harbour (Darse de Pêche), the northern entrance to which is 16.5 m. (54 ft.) wide, and the southern exit to the Duquesne basin, 19 m. (62.3 ft.) wide. The inner port (arrière-port), into the south-eastern corner of which flows the river Arques, is linked to the avant-port by the Pollet channel, dredged 1.5 m. (4.9 ft.) below datum, and



to the Duquesne basin by the Retenue lock, which is 16.5 m. (54 ft.) wide, and has a sill 1.62 m. (5.3 ft.) above datum. The arrière-port is linked further to the half-tide basin (Bassin du Canada) by a lock

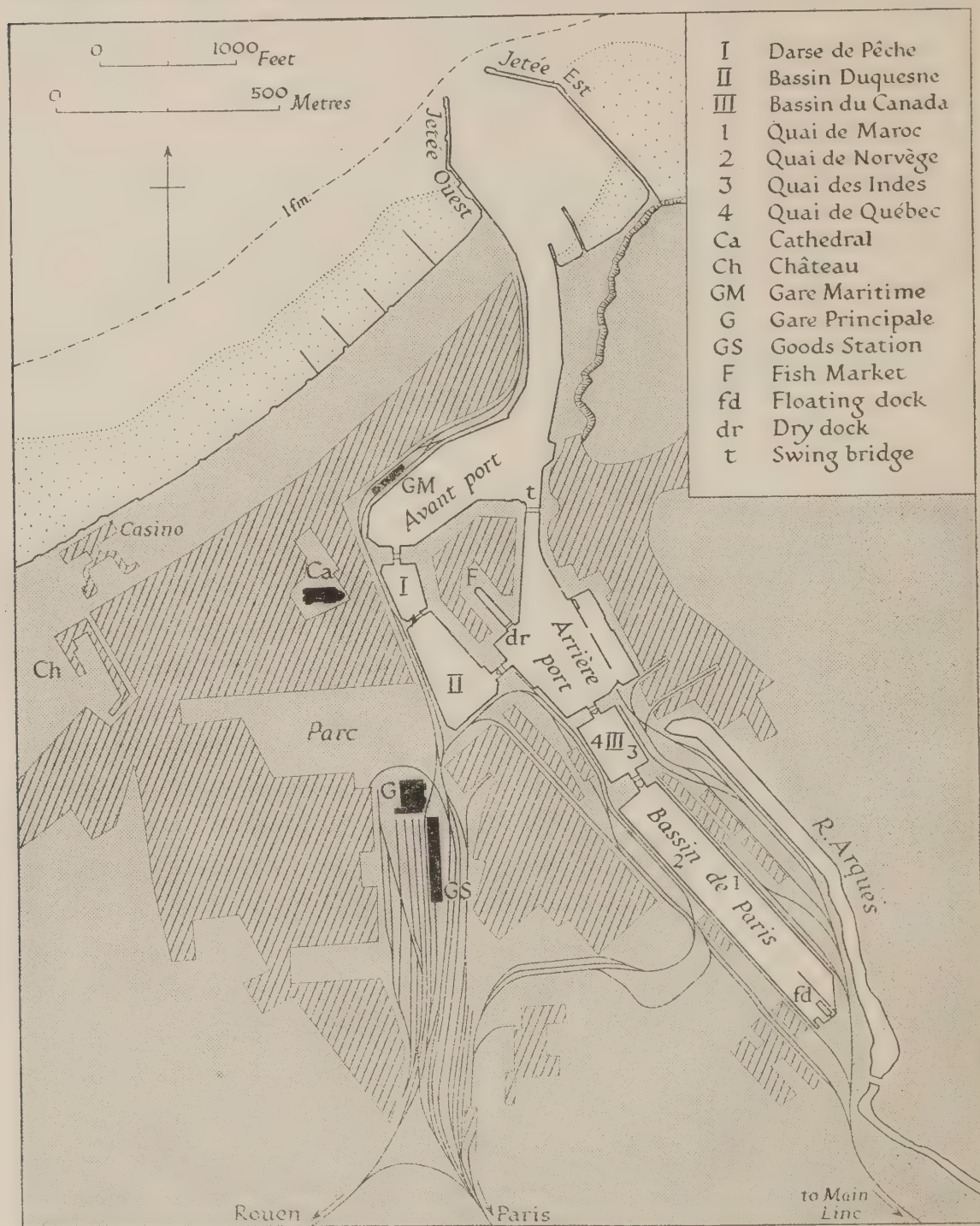


Fig. 9. Dieppe

18 m. (59 ft.) wide, with a sill 1 m. (3.3 ft.) below datum. The latter basin is linked to the wet dock (Bassin de Paris) by a lock 18 m. (59 ft.) wide, with sill at chart datum. Dredging is carried out by Diesel-engined dredgers.

The port of Dieppe falls functionally into three sections:

*The cross-Channel* port comprises 370 m. of quay, at which two packet boats and two cargo boats can berth simultaneously. It is tidal, but has depths sufficient for use at any state of the tide. On the quay are the Maritime station and a goods yard. In normal times the services to Newhaven are catered for at this quay.

*The fishing port.* Small and medium-sized trawlers fish in the Channel and return daily, laden with turbot, soles, etc. These boats—numbering 161 in 1937—use the avant-port (apart from the packet quay), the Darse de Pêche and the Duquesne basin. There is a covered fish market with modern equipment on the Ile de Pollet, immediately south of the avant-port.

*The commercial port* comprises a half-tide basin (Canada) and a wet dock (Paris). The Quai des Indes receives oil seeds from the east and from the river Plate, destined for the local oil-extraction industry which sends its products largely to England; the Quai de Québec receives grain and nitrates. Of the quays around the Paris dock the Quai de Maroc deals mainly with fruit; 100 m. of this quay also accommodates discharging colliers. The Quai de Norvège handles timber, coal and other merchandise, and is used by ships which trade regularly to Grimsby.

The following table summarizes the dock and quay facilities:

	Area ha.	Depth M.H.W.N.		Quay length m.	No. of berths for sea-going ships
		m.	ft.		
Avant-port	6.5	—	—	870	4
Darse de Pêche	1.0	—	—	—	—
Arrière-port	4	—	—	247	—
Bassin Duquesne	2.5	5.4	18.2	200	1
Bassin du Canada (Bassin de Mi-Marée)	4.5	7.0	23.0	Indes 146	1
Bassin de Paris (Bassin à Flot)	7.0	6.0	19.7	Québec 146	1
				Maroc 600	8
				Norvège 665	8
				S. wharf 146	2
Total				3020	25

Warehouse and storage space is considerable. Warehouse floor space covers 20,000 sq.m. and there are 99,000 sq.m. of open storage space on and behind the quays. The Quai de Maroc has a special heated warehouse covering 7,800 sq.m. for storing bananas; the Quai de Guynemer has a wooden warehouse of 1,400 sq.m. used for nitrates.



### *Port Facilities*

The port has about forty cranes varying in capacity from  $1\frac{1}{2}$  to 30 tons and including a large 20-ton travelling gantry; there are also four 'norias' (bucket conveyers).

Ship-repairing facilities comprise a dry dock in the Arrière-port 107.9 m. (354 ft.) long and 19.5 m. (64 ft.) wide (worked by the *Chantiers de St Nazaire*), a floating dock 49.4 m. (163.7 ft.) long and 10.56 m. (34.6 ft.) wide (lift, 700 tons) anchored at the southern end of the Paris dock, and two gridirons, all owned and worked by the Dieppe Chamber of Commerce.

### *History*

The earliest settlement at Dieppe was established on a pebble beach backed by marshes and a broad lagoon, on the western side of the mouth of the river Arques, an estuary into which flow the rivers Eaulne, Béthune and Varenne. The name is of Germanic origin and simply means 'deep', a reference to the depth of water which characterized the river mouth and which is still an important feature of the port. The old town of Dieppe, many of whose buildings date from the reconstruction which followed the bombardment of 1694, occupies a rather confined space between the docks on the east, the beach on the north, and the fifteenth-century château on its chalk cliff on the west. The modern town has expanded southwards but is still cramped in the bottom of the valley; suburban development has spread south-westwards on to the chalk plateau.

Dieppe first became important as a port in the twelfth century under the Normans, and in view of its strategic and commercial value the French kings showered privileges upon it. Being the nearest coastal port to Paris, it provided that city with salt and fish. In the fourteenth century Dieppe engaged in the Iceland fisheries, and rivalled St Malo as a base for privateer warfare. In 1339 its fleet pillaged Southampton, and in 1372 it helped that of La Rochelle in operations against the English in western France. After Agincourt the town fell into English hands in 1420, but was liberated in 1435. It was then fortified and its harbour improved, and it became a great centre of naval power and commerce. In 1530 its fleet went to Lisbon to extract satisfaction from the Portuguese for injuries to its trade; and its seamen ravaged Spanish treasure ships in the West Indies. In 1589 and 1591 Queen Elizabeth sent English expeditionary forces to Dieppe to support the cause of Henry IV, but later, when France became Britain's enemy, the privateering activities of the port

were turned against English shipping and great losses were caused. Towards the end of the sixteenth century, however, Dieppe's power was effectively broken by a combination of four circumstances—the great plague of 1668–70 from which 10,000 people died, the storm of 1672 which filled the harbour with shingle, the Revocation of the Edict of Nantes in 1685, which deprived the town of the Huguenots who were its most active traders, and the great bombardment of 1694 by the Anglo-Dutch fleet which reduced most of the town to ruins.

Dieppe was long in recovering from these disasters, and meanwhile Havre, Nantes, and Bordeaux, with superior harbour facilities, superseded it. It played but a small part as an invasion port in the Napoleonic schemes of 1801–5. Its fishing business, however, continued to prosper, the Newfoundland banks being first exploited by Dieppe fishermen in 1820. Its fortunes began to revive. The railway to Paris via Rouen was opened in 1848; the packet service to Newhaven was inaugurated in 1856, and the second main line to Paris via Pontoise was completed in 1860.

The existing port works are located for the most part on the site of the old lagoon, and most of the works were built after 1880. In that year work was begun on the construction of the *arrière-port*, connected to the *avant-port* by the Pollet channel, and by a half-tide channel (now the Canada basin) to the wet dock (*Bassin de Paris*), while soon after a graving basin was provided on the edge of the *arrière-port*. In 1895 a quay accessible at all tides was constructed adjacent to the Gare Maritime, and in 1903 the approach to the *avant-port* was rendered easier by the building of jetties designed to give protection against shingle accumulation and swell. When the channel walls showed signs of collapse in 1927, they were reconstructed with sheet piling and concrete. Between 1914 and 1922 the *Bassin de Paris* was lengthened by 170 m., and a 300 m. wharf was built on its eastern side. Further additions to this basin—a 300 m. wharf on the western side and a 70 m. jetty at the southern end—were completed in 1935. During the 'thirties also the Bérigny basin was filled in and the area converted into a public garden; in this way the inconvenience of a lifting bridge over its entrance, to carry the railway between the maritime and town stations, was eliminated. It was intended to construct at some future date three wave-traps on the eastern side of the entrance channel, in order to calm the harbour waters, for a heavy swell develops, particularly at the Quai du Cavenage, with north-westerly or north-easterly winds.

Finally, it is not surprising that on this weather-beaten shingle



coast much attention should be paid to the study of wave action—which may sometimes generate a force of 50 tons per square metre. A laboratory for wave studies was set up at Dieppe in 1927.

As a result of the 1940 operations two blockships were sunk outside the breakwater to make entrance difficult, and there were several wrecks in the basins.

### *Trade*

Dieppe is primarily a cross-Channel packet port, though it has some freight traffic and fishing as well. The passenger traffic grew from 2,000 in 1850 to 97,000 in 1890, and to 254,000 in 1930. The beaches and golf courses in the neighbourhood attracted English visitors, quite apart from the through traffic to Paris and beyond, which formed the bulk of the passenger traffic.

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Exports	442·1
Imports	111·2
Total	553·3
Coastwise trade (total)	15·9
Total sea-borne trade	569·2
Total foreign trade 1938 (provisional figures)	550·3

A leading import is coal, derived mainly from England and Wales. Colonial produce comes from French West Africa, the East, and South America. It is interesting to note that ships returning in ballast frequently carry chalk rubbish from the neighbouring quarries, or else the shingle which is present in large quantities on the beaches. Blue flints from the latter are often carried away for use in the manufacture of china. The cross-Channel traffic to and from Newhaven amounted to more than 45,000 tons in recent years; luxury goods, and fresh fruit and vegetables passed from France to England, and the French railway-owned freighters also carried many tourists' cars.

The value of the fish sold in Dieppe market increased from 2 million francs in 1913 to 45 million in 1930, and to 52 in 1937—a figure which placed Dieppe sixth in the list of French fishing ports. An elaborate system of rail transport facilities ensured the carriage of the fish to Paris and even as far as Switzerland, Italy and Spain. Oil stores were provided to cater for the increasing number of boats using Diesel engines instead of steam.





Plate 4. Dieppe: the Bassin de Paris (looking north)

This illustration shows the Quai de Maroc and coal-discharging equipment. In the foreground is the long pier projecting from the south-east end of the basin. (For map see p. 36.)



Plate 5. Havre: Bassin Théophile Ducroq (looking east)

The moored vessels are alongside the Quai Johannes-Couvert; the most distant liner is moored alongside the Gare Maritime Transatlantique, which is the usual berth of the *Normandie*. (For map see p. 42.)





Plate 6. Havre: shore equipment on the Quai Johannes-Couvert

This view is taken from the Gare Maritime Transatlantique. Beyond lies the Môle Oblique and in the distance the entrance and breakwaters. On the right can be seen a corner of the Darse Ouest of the Bassin Bellot, and beyond it the Bassin de l'Eure. (For map see pp. 42, 45.)



*Communications*

The railways serving the port can handle up to 10,000 tons of freight a day. There is a marshalling yard at Rouxmesnil. From the Gare Maritime the normal services running in connexion with the New-haven steamers passed along the edge of the docks to the town station and thence to Paris via Pontoise. Other rail services ran from the town station to Rouen (for Paris and the west of France) and via Eu to Abbeville for the north.

## HAVRE

(See Figs. 10, 11, 63; Plates 5, 6, 7, 8)

*General Description*

Havre (pop. 164,000) ranks with Rouen and Marseilles among the leading French ports, and is predominant in the American and colonial trade. It lies at the entrance to the Seine estuary, with a series of dock basins excavated in the broad belt of silt which extends along the north shore. The Tancarville Canal, which permits smaller vessels to avoid the estuary, is entered through the basins of the port.

The waters of the lower Seine carry comparatively little debris, but sand and mud banks form in the estuary. Silting does not affect the north-west pass as much as it did the earlier channel; nevertheless, in order to maintain Havre as a deep-water port, continual and expensive protection of the channels is necessary. The north-west pass was commenced in 1899; originally it was only 3 m. deep, but its depth has been increased, and the *Normandie* can now enter easily at all tides. Three dredgers are employed to keep the channel at a depth of 10·8 m. (35·5 ft.). The rise of the tides is 6·7 m. (22 ft.) at springs and 5·5 m. (18 ft.) at neaps. The level at high water remains almost constant for  $2\frac{1}{2}$  hr. with a variation of not more than 0·25 m., giving access to the port without the use of the locks for 5 hr. a day.

The vast deep-water Carosse roadstead is sheltered from north-east and north winds by Cap de la Hève. A passage 4 km. long and 250 m. wide leads in to the avant-port, which is bounded seawards by two converging breakwaters. To admit the *Normandie* it was necessary to enlarge the harbour entrance by demolishing the old south breakwater, and constructing a new one 200 m. farther south, thus widening the passage between the breakwaters to 250 m.



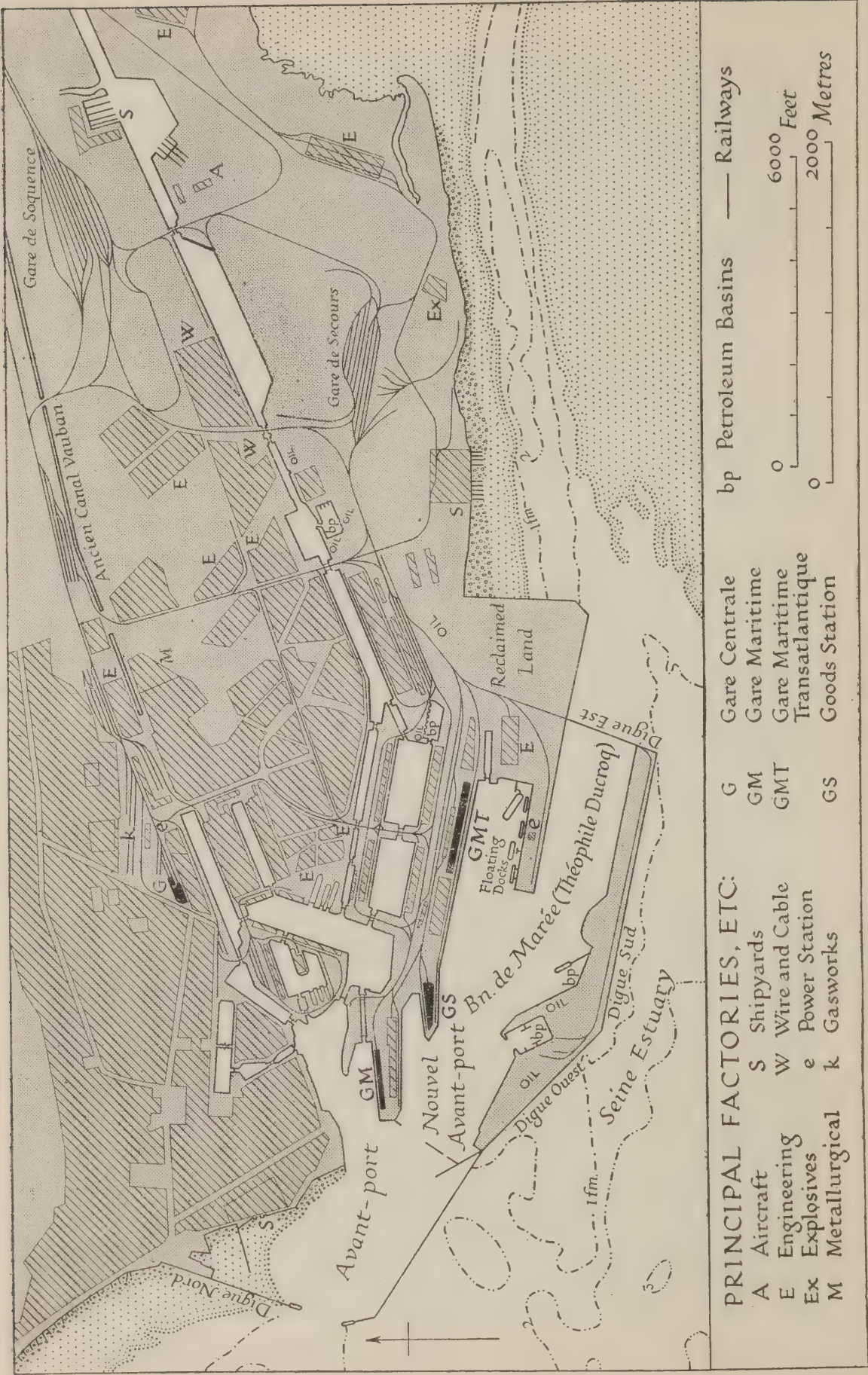


Fig. 10. Havre

The Tancarville Canal can be seen, taking a north-easterly course from the docks. The longer of the two widened sections is the Bassin Nord (not yet complete); the other widened section is a launching basin for the shipyard (see also Fig. 63).

*Detailed description*

The port of Havre comprises:

(1) The Avant-port, leading eastwards through the Arrière-port to the wet docks, and south-eastwards through the Nouvel Avant-port into the Bassin Théophile Ducroq.

(2) The tidal basin, Bassin Théophile Ducroq, together with nos. 1 and 2 petroleum basins (see Plate 5).

(3) Ten wet docks, the Bassins du Roi, de la Barre, du Commerce, de la Citadelle, de l'Eure, Vauban, Dock, Bellot, aux Pétroles and Vétillart, communicating with the avant-port and with each other by dock gates, locks and passages.

(4) The series of three small and narrow basins, Garage, Sas, and Fluvial, which form an entrance to the Tancarville Canal from the Bassin de l'Eure additional to the entrance by the Bassin Bellot, together with the Garage de Graville, a widened section of the canal, and the Desmarais petroleum dock.

(5) The Bassin Nord, a recently widened section of the canal, and part of a big scheme of extensions.

The ten wet docks and the Bassin Théophile Ducroq occupy 200 ha. of water. The quays are 22 km. long, of which more than half can accommodate ships of 8 m. (26.2 ft.) draught, and of which 3 km. can accommodate ships of 12–14 m. (39.5–45.9 ft.) draught. In the avant-port and arrière-port the quays can deal only with small vessels, except the Escale quay. The Théophile Ducroq basin can accommodate the largest vessels afloat. Berths for very large ships number three along the Escale quay, three along the Florida quay, two at the oblique mole, and five along the Johannes-Couvert quay. Access to the Bassin de l'Eure and the principal docks is limited by the largest lock, the Quinette de Rochement, to a length of 240.8 m. (790 ft.) and a beam of 29.9 m. (98 ft.). The average depth at half-tide is 9.5 m. (31.1 ft.), and there is access for 18 hr. a day. At the Quinette de Rochement lock there is a depth of 12.35 m. (40.5 ft.) at M.H.W.S. and 10.65 m. (34.7 ft.) at M.H.W.N.; the lock operates continually, except when the height of water in the avant-port is below 2.0 m. (6.5 ft.). The lock at the western end of the Bassin de la Citadelle admits smaller ships to the Bassin de l'Eure and thence to the other docks (see Fig. 11).

Details of the basins and quays are summarized on p. 44.

Nearly all the quays are used for miscellaneous traffic, but there are specialized quays for certain commodities and for cargoes brought



by river. Cargo is discharged direct on to the quay or into railway trucks, lighters seldom being used save for goods entering the canal. There are three maritime stations—on the Escale and Johannes-Couvert quays (passenger) and on the Oblique mole (goods) (see Plates 6, 8).

### *Tidal basins*

	Area ha.	Length m.	Width m.	Quays	Length in m.	Depth at M.L.W.S.	
						m.	ft.
Théophile Ducroq (Bassin de Marée)	150	2,175	700	Florida	600	9·65	31·6
				Oblique mole N and S	600	11·15	36·6
				Johannes-Couvert	1,175	12·65	41·6
				Bassin aux Pétroles:			
				No. 1	230	12·65	41·6
				No. 2	280	12·65	41·6
Arrière-port	407	407	—	d'Escale	500	10·15	33·1
				Remorqueurs	425	2·0	6·5
				Southampton	95	5·65	18·6
				Notre Dame	158	1·1	3·6
				De l'Ile	264	1·1	3·6
				Brostrom	175	1·65	5·3

### *Wet docks*

	Area ha.	Length m.	Width m.		Length of quays, m.	Depth at M.H.W.N.	
						m.	ft.
Bassin du Roi (Vieux Bassin)	1·2	160	35-100		405	4·1	13·5
Bassin du Commerce	5·4	562	96		1,244	5·0	16·5
Bassin de la Barre	5·1	450	84-245		1,025	5·0	16·5
Bassin de la Citadelle	6·0	240	110		1,050	5·1	16·7
Bassin de l'Eure*	21·3	940	200-362		1,030	5·9	19·5
					1,107	6·9	22·5
					163	7·55	24·6
Bassin Vauban	7·7	817	100		1,783	4·4	14·5
Bassin Dock	4·4	555	80		1,190	5·2	17·1
Bassin Bellot:	21·2						
Darse Ouest		440	220		1,222	7·9	26·0
Darse Est		505	220		1,420	7·45	24·4
Bassin aux Pétroles	1·5	200	80		538	7·5	24·5
Garage	1·6	230	50		212	4·35	14·3
Sas		180	30		230	4·85	15·9
Bassin Fluvial	3·3	552	60		552	3·0	10·0
					552	5·5	18·0
Bassin Vétillart	10·2	960	118		1,907	8·0	26·2
			(mostly)				
Garage de Graville	3·3	300	110		486	5·85	19·1
					120	6·5	21·3
Bassin Desmarais	—	—	—		55	4·0	13·0
					165	4·5	14·8
					25	5·0	16·5
Canal de Tancarville	—	—	—		700	8·0	26·2

\* One authority states that the length of quays in this dock is 1,940 m.

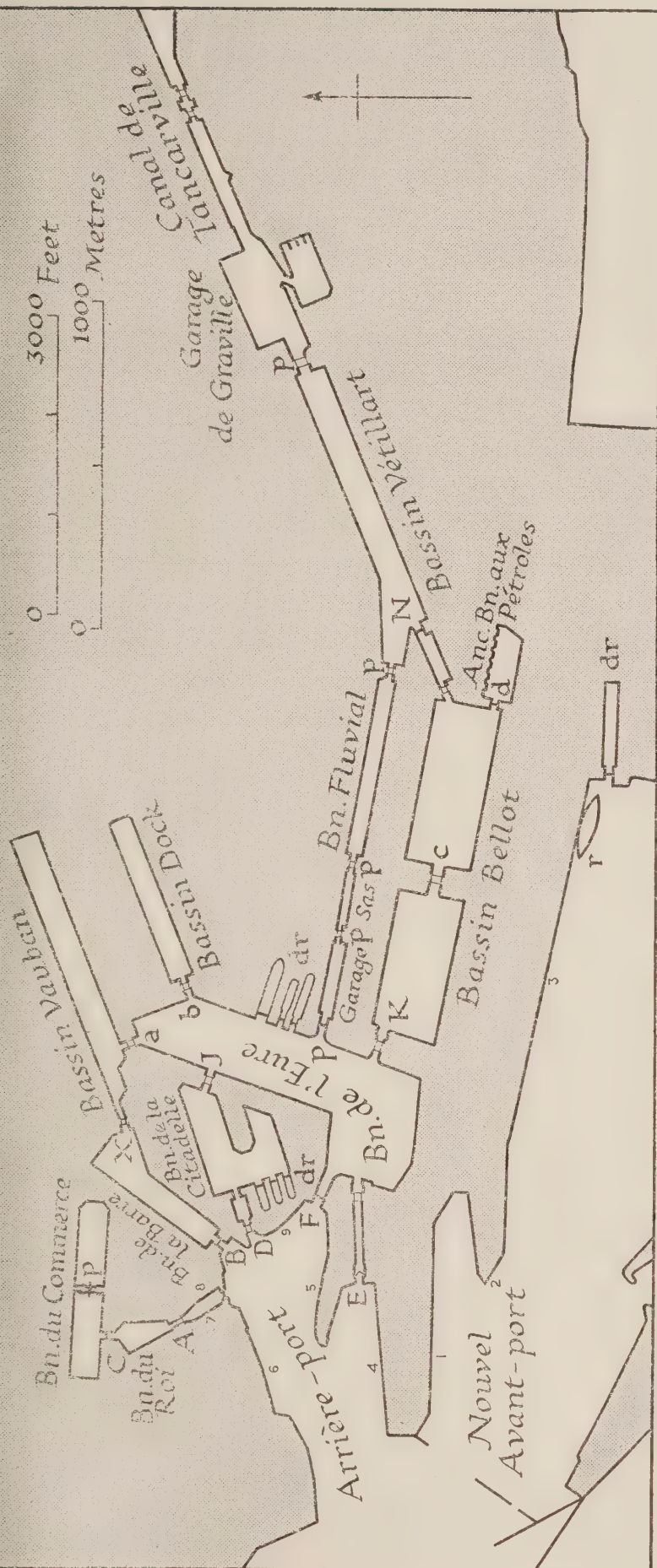


Fig. 11. The dock system at Havre

Quays in Tidal Section of Port: 1, Florida; 2, Oblique mole; 3, Johannes-Couvert; 4, d'Escale; 5, Remorquers; 6, Southampton; 7, Notre Dame; 8, De l'Île; 9, Brostrom. Bassin Desmarais (see p. 44) lies opposite Garage de Graville.

<i>Locks</i>		<i>Gates</i>	<i>Passages</i>
Lock	Width, m.	Height of bottom in relation to datum, m.	Surface width, m.  Height of bottom in relation to datum, m.
D	15·8	A	a
E	29·9	B	b
(Rochement)		C	c
N	27·4	F	d
		J	p Other passages
		K	
		X	
r = Wreck (pre 1939); dr = Dry Docks.			



Though there are two small petroleum basins within the wet-dock system, the southern part of the Bassin Théophile Ducroq is the principal petroleum harbour. The installation, of which the second dock was completed in 1933, was constructed by a subsidiary of the London and Thames Haven Oil Wharves, Ltd. Details of the petroleum port are as follows:

Wharves	Basin no. 1	Basin no. 2
Length of entry	91 m.	85 m.
Width of entry	80 m.	—
Length of basin	230 m.	280 m.
Depth below datum	10 m. (32 ft.)	10 m. (32 ft.)
Wharves for ships and tanker lighters	3	3

At the Entrepôt du Terreplein Sud: 47 reservoirs of 158,390 cu.m.

At the Entrepôt du Fort des Neiges: 19 reservoirs of 25,960 cu.m.

Extension of Entrepôt du Fort des Neiges: 13 reservoirs of 26,620 cu.m.  
6,000 m. of railway serve the reservoirs.

Most of the petroleum imported at Havre is moved by pipeline to the refineries at Gonfreville on the Tancarville Canal, or at Port Jérôme 35 km. upstream. Large tankers of 15,000 tons cannot proceed up the Seine, and are thus restricted to the limited accommodation at Havre. The Port Authority has considered a proposal to construct reservoirs in the cliffs at Tancarville to hold 300,000 cu.m., with protection against air-raid damage similar to that enjoyed by the immense caves at Caumont, in the limestone of the Marne valley, 36 km. from Paris.

### *Port Facilities*

The quays are equipped with 241 cranes of under 10 tons capacity, and twenty-seven special lifting appliances for grain, coal, timber, bananas, etc.; there are twenty-five floating cranes of under 10 tons capacity and four larger ones, of which two have a capacity of 200 and 100 tons respectively.

There is a floating dock of 16,500 tons capacity, put into service in 1930, while two pontoons for smaller ships have lifting capacities of 2,200 tons. The largest of the seven dry docks is 313 m. (1026·9 ft.) long and 34·4 m. (113 ft.) wide. There are twenty-three tugs at the port, including one of 2,400 h.p.

### *History*

The city lies on a flat alluvial plain, extending away from the river to a line of low heights—a former bank of the estuary. This low ridge reaches the sea at Cap de la Hève. As Havre was founded only just

over 400 years ago, the street plan differs from that of many French ports, for there is no old town confined within early walls. The city is well laid out, with many streets parallel to or at right angles to the waterfront.

Although there had been a Roman settlement on the site of Havre, the plain was little more than a marsh throughout the Middle Ages. The chief port at the mouth of the Seine was Honfleur on the opposite bank, while Harfleur, farther upstream, on the Havre bank, was also important. In 1517 Francis I set out to establish a new port, however, which was known first as François-de-Grace, and later as Havre-de-Grace. For some years storms impeded the work of developing the new site, and in 1533, a royal vessel of 2,000 tons, the *Grande-Françoise*, which was building there, was broken up by a storm while still on the slips. During the Religious Wars Havre was held for a few months in 1562 by an English expedition under the earl of Warwick. Later kings extended the harbour and fortified it; while Richelieu made it one of the three chief naval centres of the west, and Vauban greatly enlarged its capacity. In 1787 the engineer Lamande began the first great eastward extension, the basins of Barre and Commerce, and the walls of his time still stand firm. Increasing traffic demanded further accommodation, and in 1845 and 1887 programmes were authorized which resulted in the construction of the Citadelle, Vauban, Eure, Dock and Bellot basins, to the east of the first extension. The commercial activities of the port received a considerable impetus from an influx of refugees from Alsace after 1871. At the end of the last century the entrance to the port faced southwards, directly towards the estuary, and there was no large avant-port as at present. With the construction of training walls in the estuary, to provide an improved channel for ships bound for Rouen, disastrous silting began around the Havre entrance. The difficulty was met by providing Havre with a sheltered deep-water approach direct from the sea, entirely beyond the influence of accretion in the Seine. Two breakwaters, enclosing a new avant-port, were constructed with a westward-facing entrance approached by the 'north-west' pass.

The Quinette de Rochement lock, the Quai d'Escale and work on the north-west pass were authorized in 1895; the exterior dykes, the Bassin de Marée and the 313 m. graving dock were authorized in 1909. The opening in 1908 of the Quinette de Rochement lock lengthened the period about high water during which the docks could be entered; the opening of the Vétillart canal basin (1915)



allowed large cargoes to be landed at the Tancarville quays. During the war of 1914–18 Havre played an important part as a port for military traffic, while a neighbouring suburb became the seat of the Belgian government. Further dock extensions were authorized in 1919, and the construction of a petroleum depot at the Marée basin was authorized in 1922. The most recent extensions consisted of the widening of the avant-port to admit the *Normandie*, and the alteration of the interior mole to its present oblique position. According to the latest available information the port works have suffered only minor damage during the present war, but many warehouses have been wrecked.

A considerable scheme of dock extension is in progress. The more immediate aim is the conversion of the existing Tancarville Canal into docks; a length of the canal has been widened to form the Bassin Nord, and 650 m. of quay on the north side were completed by 1932. Work has been undertaken also to improve access by the canal to the refinery at Gonfreville. The canal has been deepened to 9 m. (29.5 ft.) as far as Bridge No. 7, in connexion with the Bassin Nord scheme, and to 7 m. (23 ft.) from Bridge No. 7 as far as the refinery. Concurrently, five swing bridges, one to the east of the Bassin Nord and four to the west, have been replaced by bascules which provide a 35 m. water passage.

Financial considerations have held up further development of the Bassin Nord. The second aspect of the scheme involves the construction of a large wet dock on the shore of the estuary to the east of the Bassin de Marée. This Bassin Sud No. 1 would contain several branch docks, and would be entered from the Bassin de Marée by means of a lock, 400 m. long and 50 m. wide, similar in construction to the Ymuiden Lock on the North Sea Canal in Holland. This dock would be connected with the Bassin Nord by means of a 'Canal de Jonction'. Further extension eastwards would eventually be carried out by the construction of a Bassin Sud No. 2, and so on.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	4,497.7
Exports	795.0
Total	5,292.7
Coastwise trade (total)	1,086.4
Total sea-borne trade	6,379.1
Total foreign trade 1938 (provisional figures)	6,667.1

Havre is the second port of France after Marseilles in terms of shipping entered and cleared, viz. 20·7 million tons in 1937, and the third port in weight of goods handled. It ranks, however, as the first port of France by value of goods imported and customs duties paid, and large stocks of goods of high value are normally stored there. Havre shares the American traffic with Bordeaux and St Nazaire, and rivals Cherbourg as a port of call for Atlantic liners. There is a considerable passenger traffic, which decreased, however, during the trade depression.

	1935 thousands of passengers	
	Entered	Departed
Long distance	33	38
Southampton	24	23
Coastal	108	98
	<hr/> 165	<hr/> 159

The great weight of imports is composed of items handled by most French ports—coal, timber, grain, rice, oil seeds. Among the small weight of exports manufactures amount to more than one-quarter. The most interesting feature of the trade of Havre is the quantity and variety of imports of American and tropical origin. It has the only cotton market in France, and indeed is the third cotton-importing port of Europe. It deals mainly in American cotton, whereas Dunkirk and Marseilles handle principally Egyptian cotton; the cotton is dispatched to Alsace (especially Mulhouse), the western Vosges and northern Jura, Lille-Roubaix-Tourcoing, and Normandy. Havre is the leading port of France for coffee and cocoa, handling 75 and 50 % of French imports respectively, although these have been reduced in the last few years. It has developed as an entrepôt port, especially for Brazilian coffee, which it distributes over much of Europe; in its extensive dealings with tropical produce such as cocoa, sugar, spices and hardwoods, it resembles London and Hamburg. In some years it handles over 90 % of French imports of hardwoods.

By 1913 an extensive series of connexions had been established in this trade with elaborate financial organization, which enabled the port to serve many customers beyond France, and gave it a supremacy in the American and colonial trade comparable to the supremacy in the African and eastern trade enjoyed by Marseilles. In the past three decades, however, the entrepôt trade of the port has diminished through the progress of other great ports. Competition for general trade has come from London and Copenhagen, and competition for the trade of eastern France from Antwerp. Marseilles has secured



much of the French import of coffee, Bremen has increased its cotton trade enough to make it second only to Liverpool as a cotton importer, and Dunkirk has secured much of the cotton and wool import of the northern coalfield. Although the interest of Havre continues in the colonial trade and in exploiting new territories concerned with it, during recent years the port has developed considerably as a petroleum importer for the refineries of the lower Seine. Lying close to the capital and upon an important route in world trade, with active industries of its own, Havre has an assured future.

### *Industries*

With a population of 164,000, or 207,000 including the suburbs, Havre is the centre of a number of manufactures, many of which are of the type frequently found in a large port—chemicals, tobacco, rope, saw milling, oil refining, flour milling and food packing, but there are also important engineering and metallurgical industries. These include a nickel, lead and zinc works, a large wire, cable and rolling mills, a Schneider factory east of the town, which manufactures motor and Diesel engines, and smaller engineering factories producing electrical and refrigerating equipment. There are three shipbuilding yards: the largest (*Forges et Ch. de la Gironde*) lies on the shore of the estuary, near Harfleur, and has four slips, the longest being 160 m. (525 ft.) long; the second (*Ch. et At. Augustin-Normand*) lies along the shore of the avant-port, with six slips for building destroyers, and nine smaller ones; the third (*Forges et Ch. de la Méditerranée*) lies on the Tancarville Canal, and has five slips 140 m. (459 ft.) long, and one smaller one. The aircraft industry is represented by two factories of the nationalized companies, one of which, situated on the canal, builds seaplanes.

### *Communications*

The port is well equipped with railways: there are 52 km. along the quays, 50 km. at Soquence marshalling yard, 14 km. south of the Vétillart basin, 14 km. at the Gare Maritime, and 32 km. in connexion with the stations. The new Soquence marshalling yard can deal with 3,000 wagons daily. There is an express service (2 hr. 50 min.) to St Lazare Station, Paris, in connexion with the Southampton packets. The railway, which crosses the Plateau of Caux and avoids the Seine meanders, normally carries out of Havre about 1 million tons of goods annually, and brings in rather more than half that quantity.



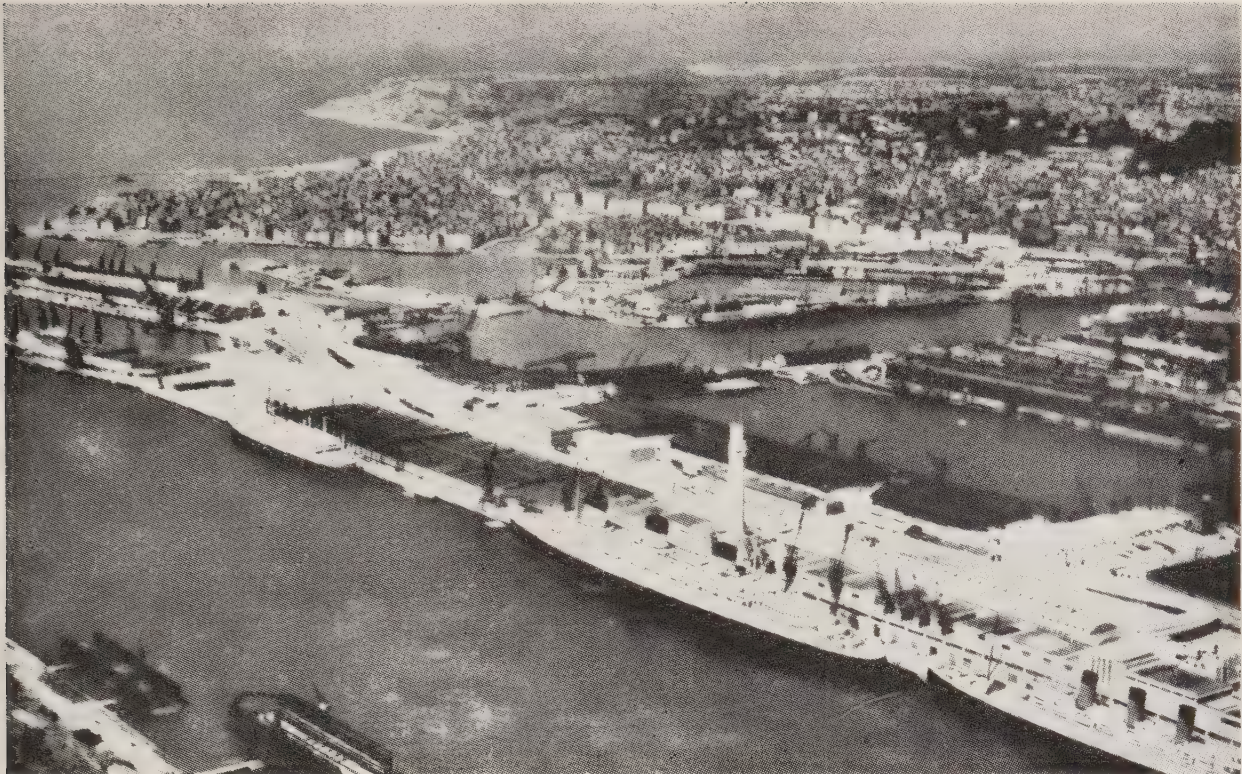


Plate 7. Havre: general view (looking north-west)

On the plain to the north of the docks lies the older part of the town, while several suburbs have spread on to the chalk plateau which culminates in the cliffs around Cap de la Hève. (For map see p. 42.)



Plate 8. Havre: Quai Johannes-Couvert

This illustration, showing the liner *Normandie* (83,000 tons gross) alongside at high water, demonstrates the low 'freeboard' of the modern passenger quays at Havre, which necessitates the use of elevated gangways. In the background is the tall tower of the Gare Maritime Transatlantique, bearing a giant tide gauge, which is graduated to show the height of the water, in metres, above chart datum.



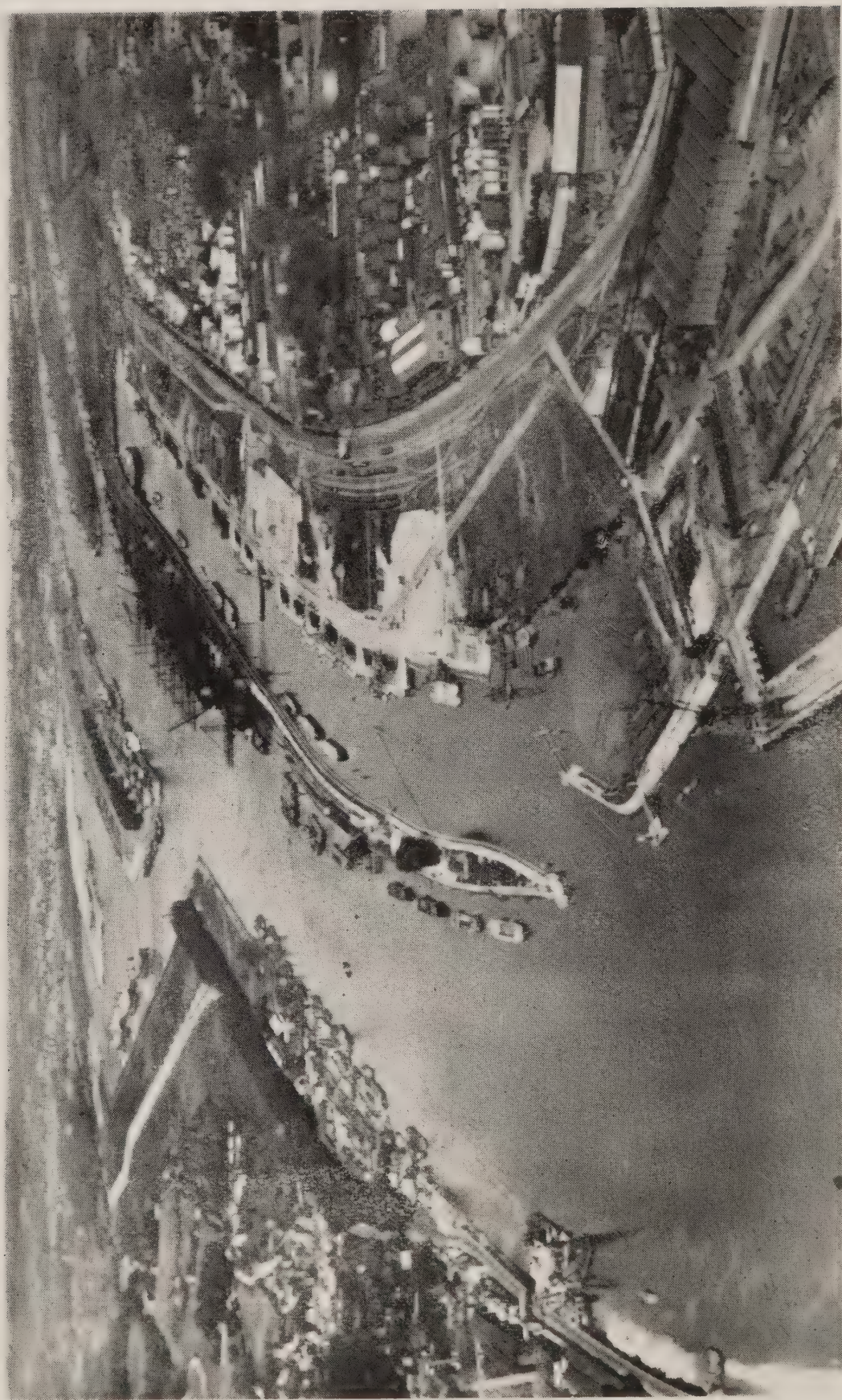


Plate 9. Rouen: general view of the middle section of the port (looking east, upstream)

In the right foreground are buildings of the *Chantiers de Normandie* (*Chantiers et Ateliers de St Nazaire Penhoët*) shipyard at Grand Quevilly. Farther upstream the Petroleum Basin opens off the river, with tanker wharves at intervals along the bank; behind are the petroleum depots. The basin is separated from the river by the Presqu'île Elie, the upstream part of which, lined with coal transporters, is one of the principal coal-discharging quays. Beyond the Petroleum Basin is the long Timber Basin, while opening off the north bank is the large port of Bassin St Gervais. (For map see p. 53.)



The Tancarville Canal, with depths of 3·3 m. (10·7 ft.), has done much to encourage trade and industrial development, although it is more important to Rouen than to Havre; it carries annually about 1 million tons of heavy goods each way. It is now being transformed into a maritime canal by further deepening to 9 m. (29·5 ft.), while the port authorities are planning a parallel canal along the edge of the Seine to accommodate future expansion of trade. Near the canal lie 4,000 ha. of land suitable for factory sites.

## ROUEN

(See Figs. 12, 13, 14; Plates 9, 10, 11)

### *General Description*

Rouen (pop. 123,000) is situated on the Seine, 125 km. from the sea and 242 km. downstream from Paris. It is the fifth port of France by tonnage of shipping, but the largest by tonnage of cargo handled. Its position at the junction of maritime and river navigation on the Seine, at the lowest bridging point, and in the heart of a busy industrial district, makes Rouen an important centre of commercial activity.

Vessels bound for Rouen wait for the tide in the Carosse roadstead off Havre, and proceed as soon as there is sufficient depth in the estuary channel. Owing to the long duration of high water they are able to reach Rouen on one tide. On the downstream journey, however, vessels of 6·1 m. (20 ft.) draught and over can seldom reach the sea on one tide. Safe anchorages, particularly that of La Corvette, upstream from Quillebeuf, enable them to await the next. But vessels under 6·1 m. draught, with a speed of 10 knots, can reach the sea in one tide by leaving Rouen at the time of low water at Havre. Tides flow as far as Martot barrage, 46 km. upstream from the city.

The 125 km. journey upstream to Rouen usually takes 7 hr.; pilotage is obligatory for all vessels and is operated in two stretches, on the lower river from Havre roads to Villequier, and on the upper river from Villequier to Rouen. The high pilotage dues are offset by the fact that ships can usually proceed straight to their berths without the assistance of tugs. The estuary has a width of 14 km. between Havre and Trouville, but gradually narrows to 1,000 m. at La Roque, 20 km. upstream, and to 500 m. at Tancarville, 5 km. farther upstream. From Tancarville to Villequier the average width of the river varies from 300 to 1,500 m., and at the port entrance it



narrows to 200 m., varying from 130 to 250 m. in Rouen itself. The channel, which varies owing to the frequent displacement of sand-banks under the influence of currents and tides, is carefully buoyed by the Seine Pilotage Service. Limits upon the size of ships using Rouen are set by the course of the river and by its depth; in the port itself there are no passages or locks. To negotiate the bends of the river vessels must not exceed 160 m. (525 ft.) in length. The channel is navigable for vessels drawing 5.5 m. (18 ft.) at H.W.L.N., 6.2 m. (20.5 ft.) at M.H.W.N. and 7.8 m. (25.2 ft.) at M.H.W.S. A ship drawing 6.0 m. (19.7 ft.) can reach Rouen virtually at any high water. Traffic is confined mainly to the medium-sized ships: of all the vessels entering the port in 1938 on a draught greater than 3.5 m. (11.5 ft.), nearly half were of 4.5–5.5 m. (14.9–18 ft.) draught.

*Draught of Vessels entering Rouen, 1938*

Draught		No. of vessels
Metres	Feet	
Less than 3.50	Less than 11.5	559
3.50–3.99	11.5–13.0	277
4.00–4.49	13.1–14.7	238
4.50–4.99	14.7–16.3	867
5.00–5.49	16.4–18.0	687
5.50–5.99	18.0–19.6	560
6.00–6.49	19.7–21.3	498
6.50–6.99	21.3–22.8	112
7.00–7.49	22.9–24.5	20
Over 7.50	Over 24.5	0

The floods of the Seine have always presented a problem and protective works have been necessary. The following table shows that port operation can be hampered during times of excessive flooding:

	Metres
Zero of the French government marine charts (i.e. low water of the lowest tides on the coast)	0.00
Lowest water recorded at Rouen	4.42
High-water ordinary neap tides	6.40
High-water ordinary spring tides	8.04
High-water equinoctial tides	8.30
Surface of newest quays	9.24
Surface of quays under construction	9.80
Level of exceptional floods: 1658	11.92
1740	11.49
1876	9.94
1910	10.05

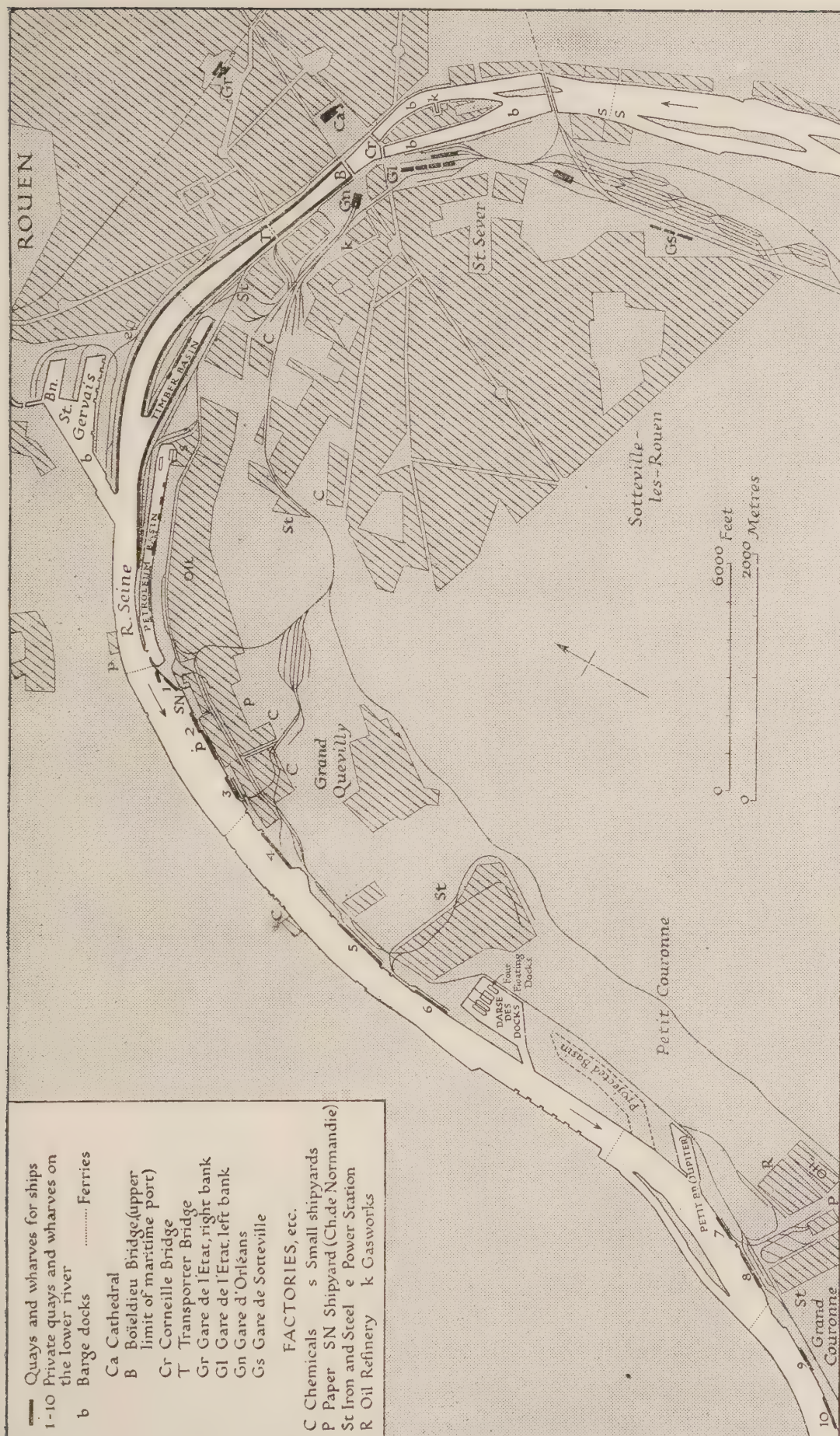


Fig. 12. Rouen



Flood water passes down the river usually between December and April. In recent decades flooding has occasionally raised the level of water to a foot or so over the quays when the tide is coming in, but navigation has not been seriously impeded. Heavy flood water increases the force of the flow on the ebb tide.

### *Detailed Description*

The maritime port includes both banks of the Seine for 18 km. from the upper limit at Boïeldieu Bridge, where the river port begins, to the lower limit below Grand Couronne. Apart from the river quays there are five basins in the port, all of which are simply basins opening off the main stream. The Timber basin covers 6 ha., the main Petroleum basin at Rouen-Quevilly 20 ha., and the new Jupiter petroleum basin at Petit Couronne 6 ha. The floating dock basin, covering 18 ha., is used only for repair work at the four floating docks. The Bassin St Gervais, covering 20 ha., and comprising two branches, is a barge port. Altogether, the port of Rouen provides 157 berths for ocean-going ships:

Berths at: 9355 m. of quays	87
Wharves and specialized landing places	33
Ducs d'Albes (mooring posts)	24
Mooring buoys	13
Total	157

The eighty-seven berths at public quays are distributed as shown in the table on p. 55.

These public quays thus provide the following berthing accommodation:

2404 m.	at 5.0 m. (16.5 ft.)
409 m.	at 6.2 m. (20.5 ft.)
5975 m.	at 7.5 m. (24.5 ft.)
567 m.	at 8.2 m. (27.0 ft.)
Total	9355 m.

The two petroleum basins provide ten berths at their specially equipped discharging wharves: Petroleum basin (Rouen-Quevilly), eight berths at 7.3 m. (24 ft.); Jupiter basin (Petit Couronne), two berths at 9.1 m. (30 ft.). The remaining twenty-three berths at wharves include those belonging to private companies, which are not usually available for ships in general trade, together with two repair berths. The thirty-seven berths at mooring posts and buoys are almost entirely for the use of waiting ships, although one post is

available for ships discharging into lighters and three are repairing berths.

Quay	Length m.	No. of berths for sea-going ships	Depth at lowest water	
			m.	ft.
Right-bank river quays:				
Bourse	370	3	5.0	16.5
Havre	409	3	6.2	20.5
Gaston-Boulet	388	4	5.0	16.5
Boisguilbert	984	8	7.5	24.5
Emile-Duchemin	669	6	7.5	24.5
Nouveau quai	567	5	8.2	27.0
	3,387	29		
Left-bank river quays:				
Cavelier de la Salle	826	9	5.0	16.5
Jean-de-Béthencourt	820	8	5.0	16.5
De la Presqu'île Rollet	1,017	10	7.5	24.5
De la Presqu'île Elie	1,027	10	7.5	24.5
Soc. des App. de l'île Elie	200	2	7.5	24.5
	3,890	39		
Timber basin:				
De France	923	9	7.5	24.5
Sud de la Presqu'île Rollet	130	1	*	
	1,053	10		
Left-bank quays downstream:				
Cie. Rouennaise de Décharg.	294	2	7.5	24.5
Soc. Nouvelle de Papeterie	273	2	7.5	24.5
Soc. Comm. des Potasses d'Alsace	148	2	7.5	24.5
Soc. Grande Carue	310	3	7.5	24.5
	1,025	9		
Total	9,355	87		

\* Depth presumed to be 7.5 m. (24.5 ft.).

The lengths of quay devoted to special uses are as follows:

Cargo	Length of quay, m.	No. of berths
Coal	3,320	31
Wood	1,900	17
Wine, etc.	1,620	14
Various	2,470	17
Oil wharves	—	16

Sheds cover 54,000 sq.m., of which 48,500 are accounted for by twenty-seven public sheds on the right bank quays. The storage grounds of Rollet peninsula are used for coal. The former island of Elie has 500 m. of wharf equipped with 3 km. of railway and a coalyard capable of storing 40,000 tons. The Petroleum basin is the largest oil dock in Europe. The newer Jupiter basin was opened in



1932. There is a considerable tankage in the port; the refinery near the Jupiter petroleum basin at Petit Couronne, completed in 1932, has an annual capacity of 900,000 tons (see Plate 10).

### Port Facilities

The lifting equipment is considerable, and comprises 195 shore cranes and eighty-nine floating cranes of under 10 tons capacity,

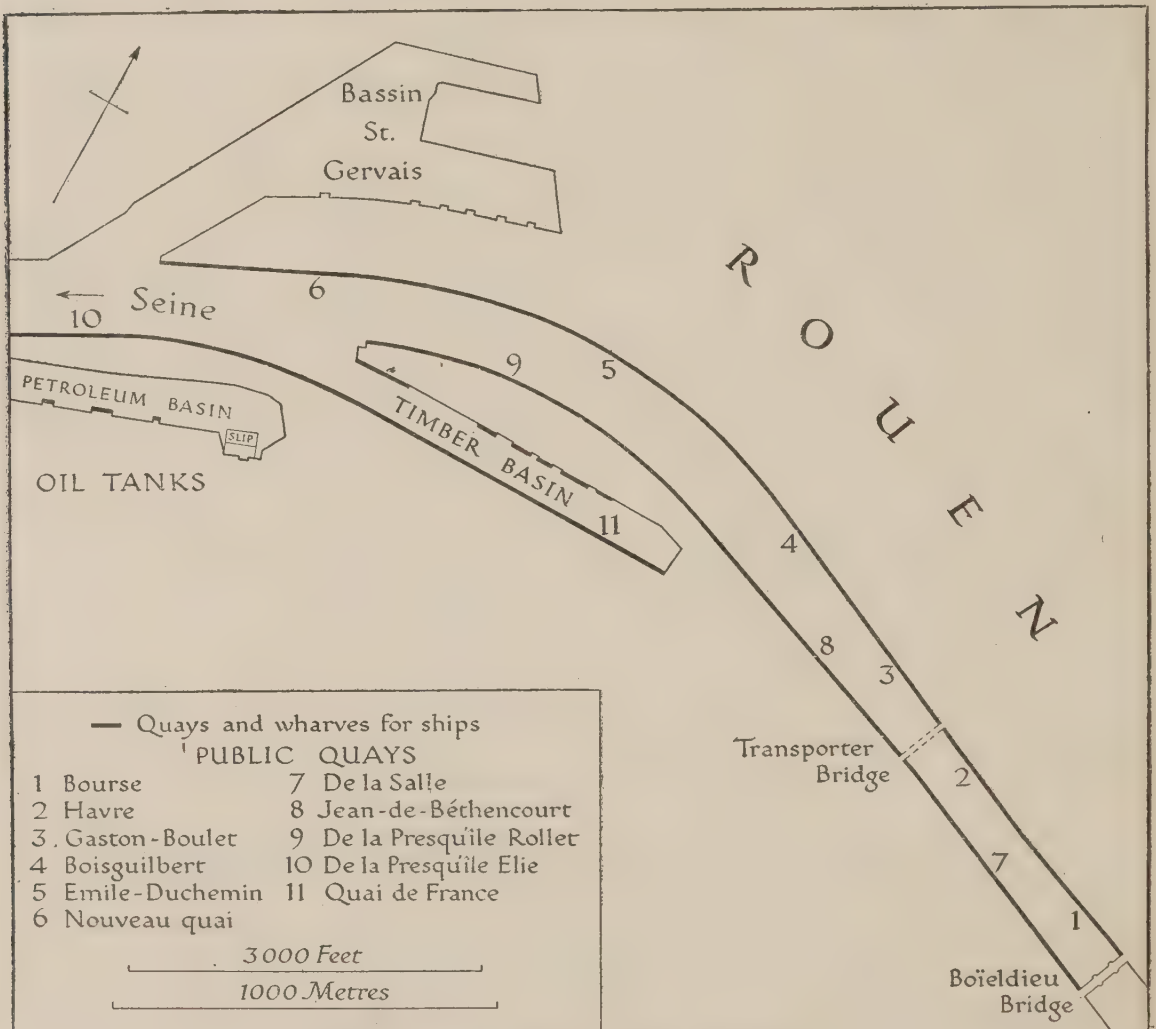


Fig. 13. The upper quays at Rouen

twenty-one specially designed transporter cranes mainly for handling coal, specialized equipment for grain and banana traffic, together with one 20-ton electric crane and one 60-ton floating crane. This crange is capable of giving very high rates of discharge for coal cargoes, up to 3,000 tons in 24 hr. Colliers are frequently able to discharge and sail on the following tide.

There are no dry docks at Rouen, and facilities for repairs are provided by five floating docks which are moored in the floating

dock basin. These docks have capacities of 14,000, 8,000, 4,200 and 4,200 tons. There is also a repairing slipway.

### *History*

The site of Rouen is unique among all the towns of the lower Seine. It lies on the right or northern bank of one of the incised meanders of the river, on a low terrace about 10 m. above the river. This site was free from all but the worst floods, yet close to navigable water. The extent of this platform allowed the city to grow to a considerable size before reaching the steep hill sides which bound the valley. Other towns on the outer curves of meanders possessed no such platforms over which they could expand, and hence Duclair and Caudebec, although nearer the sea, have remained small towns, shut in by the steep valley side behind them.

Rouen was an important town in Gaul both before and after the Roman occupation, and was the seat of a bishopric as early as A.D. 260. It suffered raids by the Norsemen who sailed up the river; in 876 Rollo established his headquarters there, and in 911 was recognized as duke of Normandy by the king of France. Rouen became important as the capital of an almost independent Normandy. By the fourteenth century the city had developed an active trade with the Hanseatic cities, and became also the principal arsenal for the royal naval forces. The prosperity and importance of medieval Rouen were reflected in the building of many churches, which make the city one of the most interesting, architecturally, in France. The progress in trade was cut short by the later struggles of the Hundred Years' War, for in 1419, after seven months of blockade, the city was captured by the English, and it was in the market-place of Rouen that Joan of Arc was executed. Eventually, in 1449, the English forces withdrew, attacked by the king of France from without, and by the people of Rouen from within. A further period of strife and bloodshed troubled the history of Rouen during the religious civil wars. Trade revived in spite of these disturbances, however, and the city took an active part in French maritime expansion after the discovery of America. Samuel Champlain set out from Rouen to explore the St Lawrence, and the Cavelier de la Salle opened up the Mississippi valley. It played no great part in the Anglo-French wars, although it was a base in one of the Napoleonic invasion schemes. These wars interrupted commercial progress, but in the nineteenth century its trade grew apace. Its expansion was related directly to the growth of Paris and to improvements effected in the navigability of the Seine.



By means of great engineering works, beginning with the dyking of the estuary in 1848, the channel was deepened from 3.5 to 9.5 m. Before rectification and improvement works were put in hand, the river below Rouen, for the greater part of its length, had followed a fluctuating channel, and navigation was difficult owing to its constant changes in depth and direction. The programme of improvements started in 1848 involved extensive dredging and the construction of training walls and embankments. By the end of the century the whole of the lower Seine had been transformed: considerable areas of land had been reclaimed, and whereas formerly vessels of 200 tons navigated the river with difficulty, vessels of ten times the tonnage now effected the journey with ease. The improved approach allowed trade to increase from a few thousand tons in 1840 to 1 million in 1878 and 5.6 million in 1913.

As the population of Rouen grew in the past hundred years, the built-up area expanded into tributary valleys. When the railways were constructed extensive tunnelling was necessary, and the lines took up comparatively little space in the city. At the same time the suburbs of St Sever and Sotteville-les-Rouen grew up on the extensive flat ground of the left or southern bank, inside the meander, together with all the factories which require much space. These suburbs were to attain eventually a population almost as great as that of the city itself.

During the war of 1870 Rouen was occupied by the Germans for six months. In the war of 1914-18 it became an important supply centre for the British armies, owing to its excellent communications. Enormous base camps were established in the neighbourhood, and in 1918, 10 million tons of cargo entered the port. In the present war, Rouen fell when the bridges above the city were occupied by German forces.

An important problem for future development arises from the depths in the Seine. The *mascaret*, or bore, which used to endanger river craft or vessels at anchor, has been reduced by dredging and is now only felt from Quillebeuf to Mailleraye, and when the tide is more than 8 m. (26.2 ft.), i.e. for 20-25 days a year. The double tide felt at Havre diminishes up the Seine, and its amplitude is reduced by the time the flood reaches Rouen. During 1938 work was in progress for confining the river to one channel in the lower estuary, below the river Risle, so as to allow vessels of 8 m. (26.2 ft.) draught to enter Rouen at all tides. Up to September 1939 the embankments forming the first part of the sea wall had been finished, and in 1937

a dredger of 2,000 cu.m. hourly capacity was put into service. The stabilization of the channel is illustrated by the fact that whereas during the year 1896 it followed six different courses, it remained in almost the same position for four years, 1917–21, and since that date the river has discharged into the sea through the central channel, and its general outline has not altered. Minor shifts of the deep-water buoyed channel are still necessary from time to time, but with the completion of the improvement works it is expected that an absolutely unchangeable channel between the Amfard bank on the north and the Ratier bank on the south will be attained.

Owing to its exceptional geographical position, with a hinterland which includes the most prosperous districts of France, the port of Rouen is likely to develop considerably. Its economic importance has doubled every 15 years. The value of its inland location is aided by the fact that maritime freight rates to Rouen are very little higher than those prevailing for neighbouring ports on the channel, the difference rarely amounting to 3*d.* per ton.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	7,631.7
Exports	670.3
Total	8,302.0
Coastwise trade (total)	1,465.0
Total sea-borne trade	9,767.0
Total foreign trade 1938 (provisional figures)	7,701.6

The trade of the port is very unequally divided, with exports amounting to 10–15 % of the weight of imports. The import trade is dominated by the coal traffic, for which Rouen is the largest importing centre in France, handling more than the combined coal imports of Bordeaux and Marseilles. As the maritime freight rate for coal is the same to Havre and Rouen, most cargoes move direct to the upstream port. In 1913 Rouen imported 20 % of the French coal import and in 1918 39 %, a record year when 33,600 tons were discharged in one day. Owing to this heavy traffic a great proportion of the weight of all French imports passes through Rouen—more than a quarter in 1930 for example. The coal import has decreased, however, in recent years, from over 5 million tons in 1930 to about 3 million tons, largely owing to quota restrictions imposed in 1931. About one-quarter of the coal is used locally, the bulk is sent to the



Paris region, and the remainder to more distant departments. At times coal is even sent by rail to Basle; in 1935 the amount was 70,000 tons, but in recent years this long-distance traffic has practically ceased. In addition to the import by sea there is also a considerable movement of coal to Rouen by rail from the northern coalfield of France.

*Sources of Sea-borne Coal Imports of Rouen, 1938*  
(thousand metric tons)

Great Britain	1,937	U.S.S.R.	74
Germany	565	Belgium	14
Poland	363	Holland	7
Indo-China	116	Other countries	38
Total		3,114	

A very heavy import of petroleum, etc. brings the import of fuels up to a quantity exceeding one-half of the total import of the port. The remaining imports of Rouen are those of a great industrial centre—timber, wood pulp, heavy chemical raw materials and minerals. The quantity of foodstuffs is comparatively small, but the wine import from North Africa is enormous—875,000 tons in 1938. Some of the food imports, such as wine and bananas, are sent far afield within France.

Among the comparatively small quantity of exports, the principal item is metals of various kinds, followed by manufactures and refined fuels, but there is also an export of plaster, cement, and Fontainebleau sand, which is sent to England for glass manufacture. Trade is fostered by regular services to European and north African ports, and in 1933 a line to the French Antilles was established. The passenger trade is very limited.

### *Industries*

The activities of the port of Rouen are by no means derived only from the demands of Paris, for industry is the main support of the 261,000 inhabitants of the city and the adjoining urban areas. Rouen is a centre of some importance for shipbuilding. In addition to various yards for repairs and the building of small vessels there is a large yard at Rouen-Quevilly, belonging to the St Nazaire Penhœt company. This yard has six slips, up to 152 m. (500 ft.), and builds ships up to 17,000 tons; the engines are constructed at the St Nazaire works. There are several engineering works and a blast-furnace plant. The cotton textile industry of the Rouen district is long established and

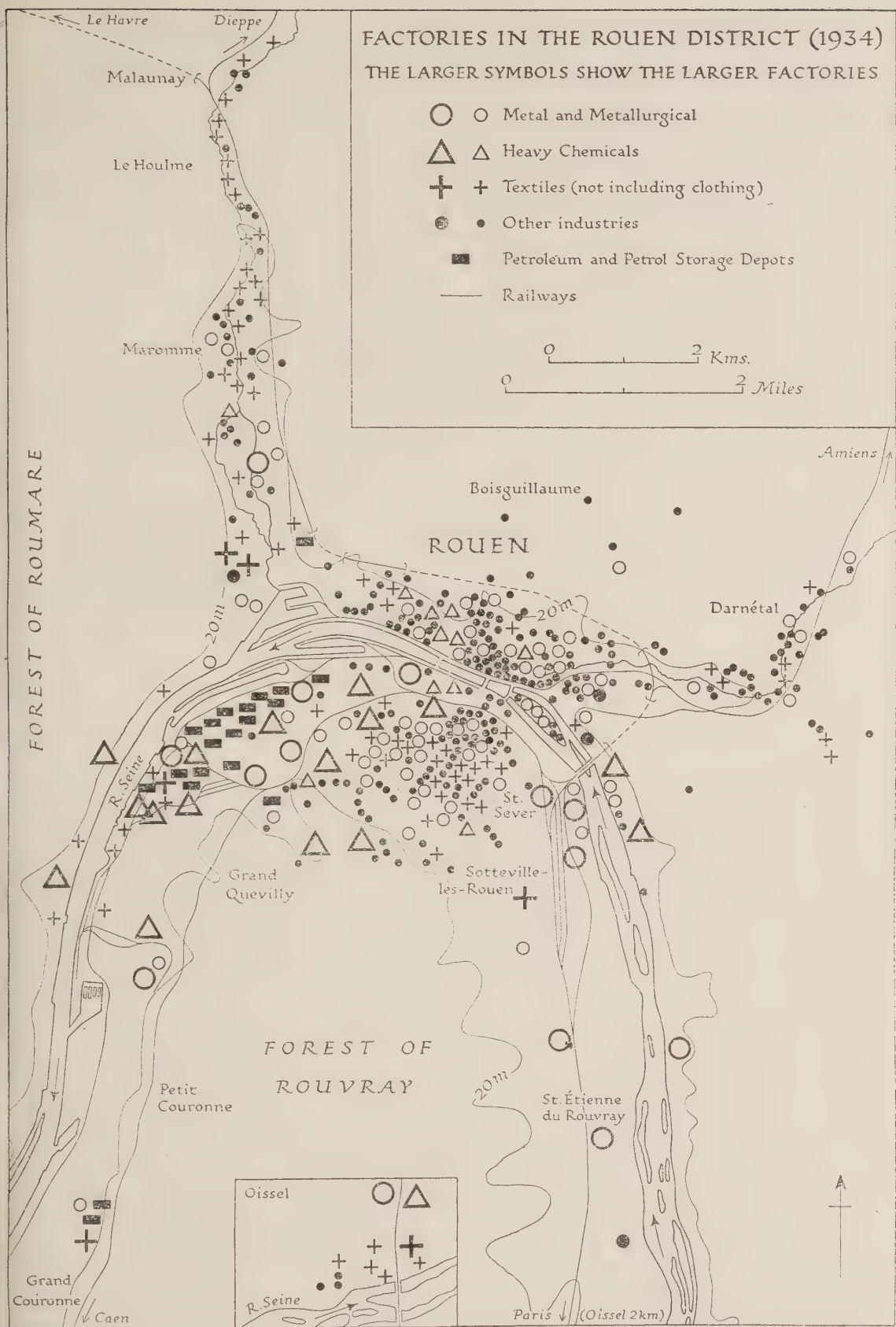


Fig. 14. The industries of Rouen

Most of the factories in the city itself are small establishments, such as printing works, clothing factories, etc. The map shows how the factories have been located as far as possible on the ground below 20 m., especially those which demanded extensive areas of flat ground, such as the engineering and chemical works and petroleum depots. The great concentration of textile mills in the tributary valleys is clear, but there are also many mills in the suburbs of Rouen, Sotteville-les-Rouen, and St Sever. The principal marshalling yards lie at Sotteville.



famous. Since the war of 1914-18, the chemical and engineering industry had expanded, especially since 1918, an expansion reflected in the reduction of paper imports from 120,000 tons in 1926 to 31,000 tons in 1936. All the paper mills save one lie on the left bank at Grand Quevilly and at Croisset (see Fig. 14).

### *Communications*

Railways within the port have grown as follows:

	Length of quays	Length of railways
1900	4.147 km.	30.623 km.
1938	9.355 km.	139.652 km.

Of these lines 35.5 km. lie on the north bank and 103.5 km. on the south bank. The railway gradients to Paris are easy, and the lines have a maximum daily capacity of 22,000 tons. The railways take about a third of the trade to and from the port. Of the imports 50-60 % are moved up the Seine by means of 770 dumb barges, 265 oil-tanker barges, and thirty-nine wine-tanker barges. The port continues for 17 km. above Boïeldieu Bridge as a river port.

An interesting project under discussion is the provision of a crossing of the Seine at Tancarville between Havre and Rouen. Havre interests propose a suspension bridge, but the Rouen port authorities are in favour of a tunnel.

## SUBSIDIARY PORTS OF THE LOWER SEINE

(See Fig. 15; Plates 12, 13)

The small port of Duclair (pop. 1,400) lies 87 km. from Havre on the right bank of the Seine. It can admit vessels up to a draught of 5.5 m. (18 ft.) at H.W.L.N., 6.2 m. (20.5 ft.) at M.H.W.N. and 7.2 m. (23.5 ft.) at M.H.W.S., and not exceeding a length of 160 m. (525 ft.). The port could not be used in 1939 as its quay, 140 m. long, was in course of reconstruction. The remaining ports of the lower Seine are annexes of Rouen, and conditions of access are similar to those governing the larger port. The accommodation and traffic of these ports may be summarized as on p. 63.

It is clear that several of these ports are little more than mooring points, and all of them are of minor importance in foreign trade. Only Duclair and Port Jérôme carry on any significant coastwise trade. The heavy outward traffic of Port Jérôme is composed of refined petroleum products; the crude petroleum is conveyed to the



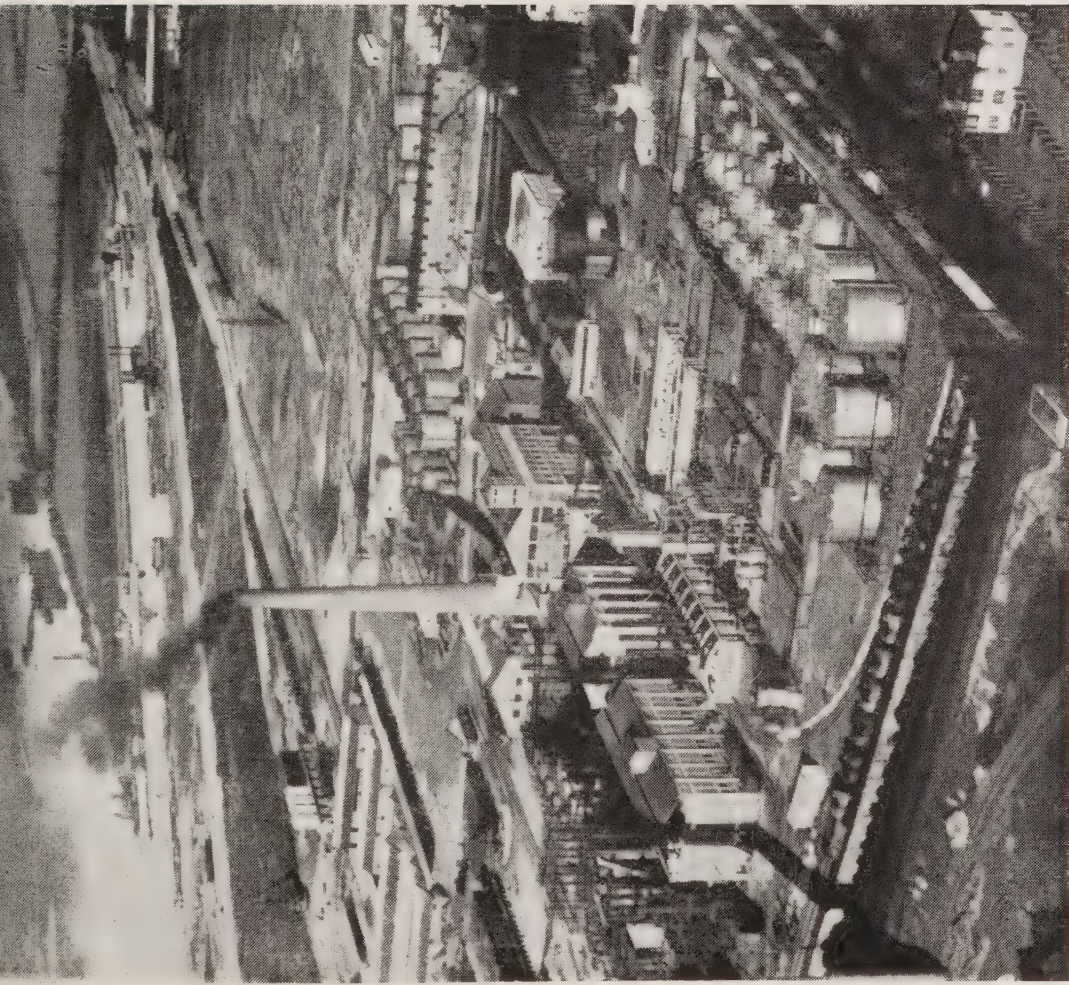


Plate 10. Petit Couronne, Rouen: the Jupiter oil refinery  
Beyond the refinery is the Jupiter petroleum basin (Petit Bassin des Hydrocarbures). (For map see p. 53.)

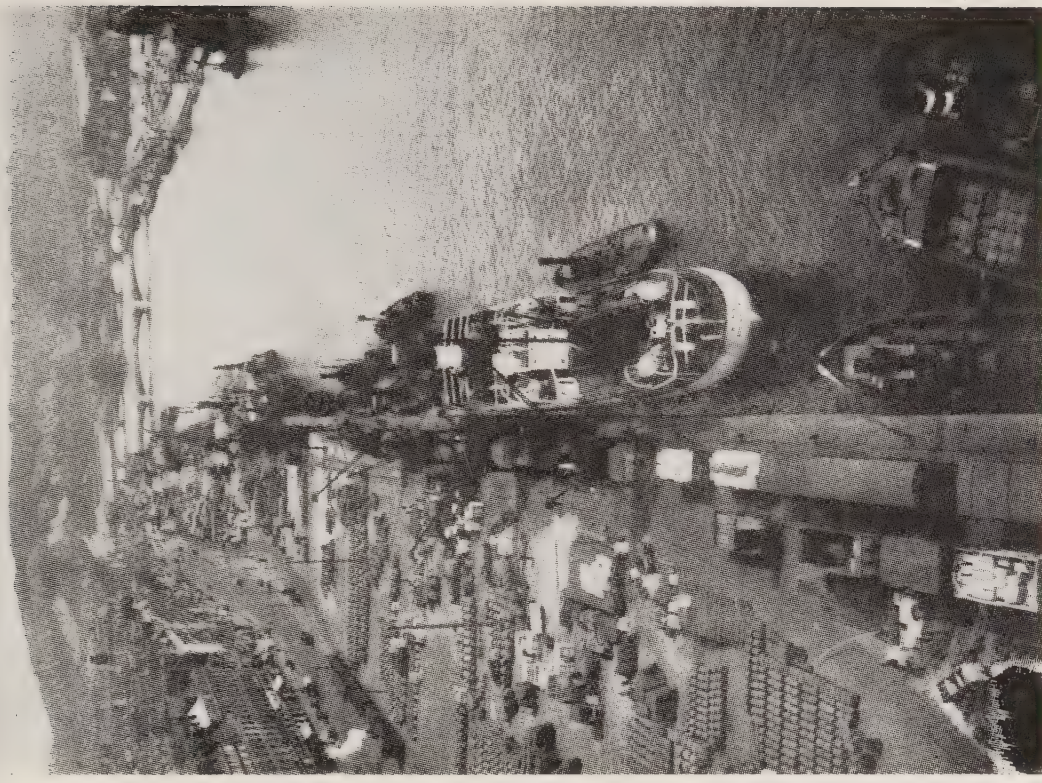


Plate 11. Rouen: the river quays (looking south-east, upstream)  
This view, from the Transporter Bridge, shows the Quai du Havre and Quai de la Bourse. The city lies to the left on the north or right bank. In the background is the Boieldieu Bridge, the upper limit of the maritime port. Beyond lies the Cornelle Bridge and the Ile Lacroix. (For maps see pp. 53, 56.)



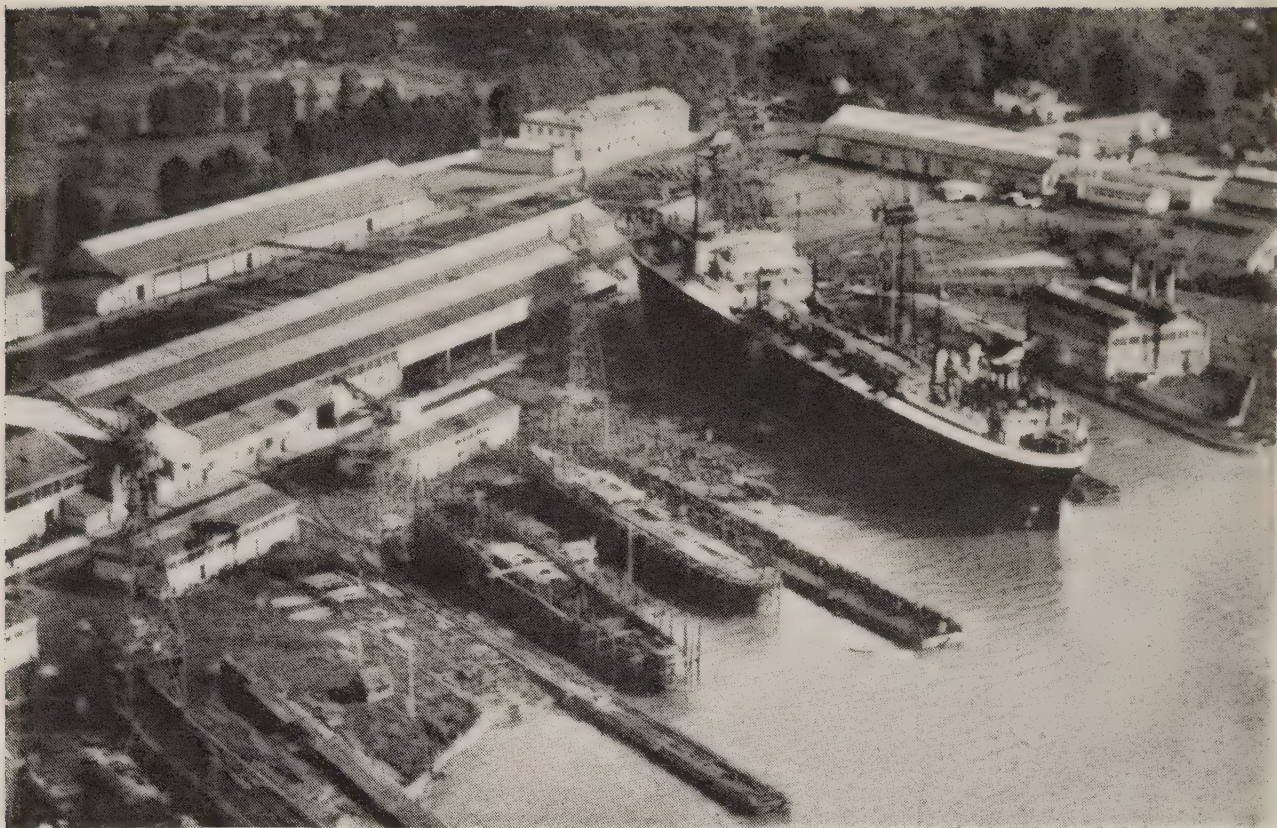


Plate 12. Le Trait shipyard

Of the eight building slips at this yard, which is owned by *Ateliers et Chantiers de la Seine Maritime (Worms et Cie)*, the longest is 180 m. (590 ft.). A large tanker is seen at an advanced stage of construction. (For map see p. 63.)



Plate 13. Gonfreville: the coaster discharging berth at the *Compagnie de Raffinage de Normandie* refinery

The refinery lies on the south side of the Tancarville Canal. The chalk bluffs in the background mark the original north bank of the Seine. (For map see p. 63.)



two refineries by pipe-line from Havre. The larger of the two refineries at Port Jérôme is the largest and most modern refinery in Europe.

Cargo Movements, 1937 (in thousands of tons)

	No of berths	Draught	Foreign trade			Coasting trade			Grand total
			Im-ports	Ex-ports	Total	In-wards	Out-wards	Total	
Duclair	2 (under repair), 3 (mooring buoys)	6.0 m. (19.7 ft.)	24.7	0.3	25.0	34.8	67.4	102.2	127.2
Gonfreville	2 (at wharves)	As for Rouen	—	—	—	—	—	—	—
Jumèges	1	"	—	—	—	—	—	—	—
Mailleraye	1	"	19.4	1.5	20.9	6.6	1.5	8.1	29.0
Port Jérôme	1	"	—	—	—	—	—	—	—
Tancarville	1	"	21.0	—	21.0	0.8	—	0.8	21.8
Villequier	1	"	—	—	—	—	—	—	—
Vatteville	1	"	—	—	—	—	—	—	—
Port Jérôme	3	"	—	39.5	39.5	3.9	783.7	787.6	827.1
Total					106.4			898.7	1,005.1

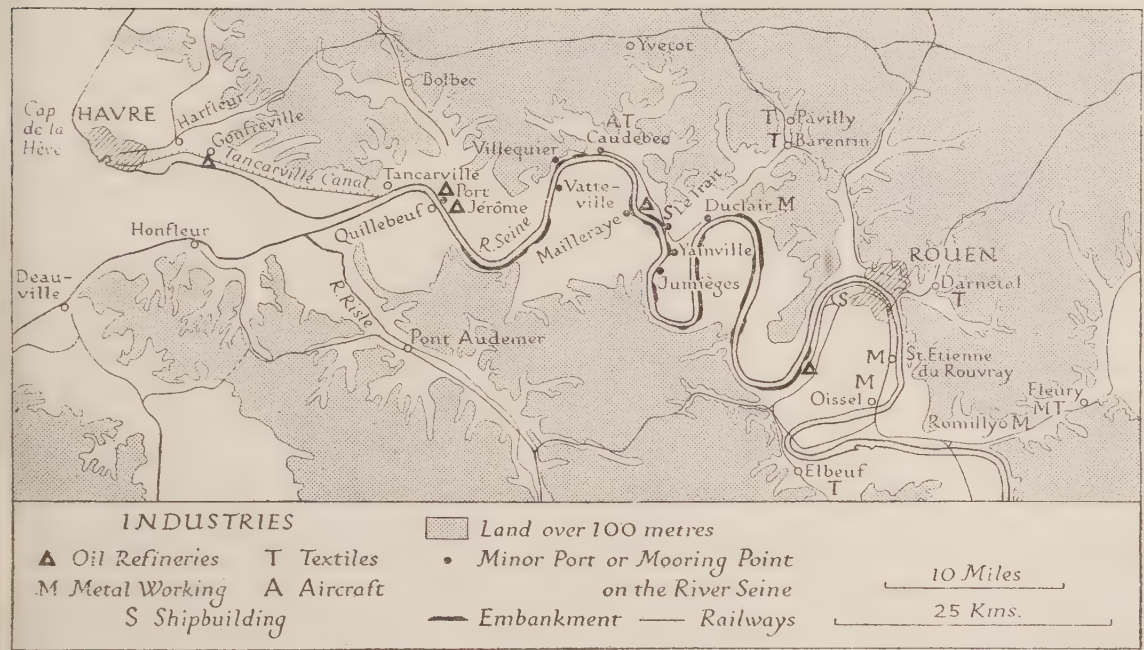


Fig. 15. The lower Seine

Another refinery is situated at Mailleraye, of a specialized nature and producing heavy oils and greases, while a third lies on the Tancarville Canal at Gonfreville-Orcher, 12 km. from Havre.

The refining industry is a dominant factor in the present and future prospects of several of the lower Seine ports, and will affect also the fortunes of Havre and Rouen. In the past 10 years the economic importance of the lower Seine has been enormously increased by the



establishment in France of a complete refining industry, which involved the construction of refineries along the river additional to those existing at the two great ports. The capacity of the river refineries in 1939 was as follows:

Location	Means of conveyance of crude oil	Annual capacity tons
Gonfreville-Orcher, 12 km. from Havre	Pipe-line from Havre	1,500,000
Port Jérôme, 40 km. from Havre: (1)	"	1,500,000
(2)	"	400,000
Mailleraie (heavy oils and greases)	—	100,000

So far the development of the oil-refining industry has led to a greater increase of tanker traffic at Havre than at Rouen, but congestion occurs at the former, and at times it has been necessary to divert large tankers to Pauillac on the Gironde estuary. The supply of the Port Jérôme refineries by the pipe-line from Havre seems to be designed only as a temporary measure and plans have been made to relieve the congestion in Havre by building a dock at Port Jérôme when the Seine has been deepened. This dock will be parallel to the river, 600 m. long and 200 m. wide, with a lock and sluices leading to wet docks. Work on the outer harbour was completed in 1933. The scheme is being carried out under the auspices of the Rouen Chamber of Commerce.

The refining industry in the lower Seine involves considerable operations by various forms of transport. Its products are carried westwards by coasting ships, by road or rail to Picardie and Basse-Normandie, by the Seine and Oise to the north and east of the Paris Basin, and by the Seine and the Loing and Briare Canals almost to the centre of France. The future will see probably something of a struggle between pipe-line transport and the inland waterway and rail systems, for a proposal has been made for the construction of a gasoline pipe-line from Havre to Paris, and another proposal even envisaged a pipe-line between Rouen and Bordeaux which would serve all western France. Thus, although so far the petroleum imports of Havre have increased more rapidly than those of Rouen, the deepening of the Seine to Port Jérôme will reduce them, and the deepening of the river farther to Rouen would reduce them even more.

Other industries along the lower Seine include a shipyard at Le Trait, set up during the war of 1914-18, with an annual capacity of 30,000 tons (*At. et Ch. de la Seine Maritime*). This yard has eight

slips, the longest of which is 180 m. (590 ft.); vessels up to 18,000 tons have been constructed here, but the majority are smaller (see Plate 12). Recently Caudebec, which for some time had a very small aircraft factory, became the seat of a branch of one of the nationalized companies.

At each end of the lower Seine the two great ports are expanding their urban area, and leading to the growth of satellite towns. East of Havre, Harfleur and Montivilliers are growing with the expansion of engineering and milling industries in that area. Rouen has long been the centre of several groups of small textile towns spreading along the valleys which radiate from it, and in recent years some of these satellites have grown further, especially Oissel and Barentin. The most recent growth has been due to a variety of industries, for the cotton textile industry has ceased to develop. Oissel, for example, now has a branch of the engineering industry of Commentry in the Central Plateau and manufactures railway material, and a branch of one of the largest French chemical manufacturing companies was recently established there.

*The Tancarville Canal* (see p. 379). This canal is not a purely inland waterway, for while most of its traffic is in barges, smaller sea-going vessels make use of it. The function of the canal is to allow smaller craft working upstream from Havre to avoid the passage through the estuary proper. From its entry in the Eure basin at Havre, the canal runs at the foot of the Plateau of Caux along the north shore of the rapidly narrowing Seine estuary, entering the river at Tancarville, where a promontory of the plateau juts out to the south. It is 25 km. long, and sends an 800 m. branch to serve the little river port of Harfleur. In Havre itself the width varies from 16 to 150 m.; for the rest of its length it is 25 m. wide. The depth is 9 m. (29.5 ft.) to Bridge 7 at the eastern end of the Bassin Nord at Havre, 7 m. (23 ft.) from Bridge 7 to the C.F.R. refinery, and 3.50 m. to the exit in the Seine. Up to September 1939 improvements to the canal have resulted mainly in the development of its lower end as docks for the port of Havre, but it allows transshipment at Havre into smaller vessels for Rouen and the river ports upstream, and in recent years it has carried about 1 million tons of heavy goods outward and 600,000 tons inward, mostly coal, and petroleum. It is now being transformed into a ship canal by deepening to 9 m. (29.5 ft.).



## CAEN

(See Figs. 16, 17; Plates 14, 15)

*General Description*

Caen (pop. 61,000) owes its position largely to the development since 1900 of the Normandy iron ores. It lies on a plain, 15 km. from the sea, with which it is connected by a maritime canal, for the river Orne proved inadequate for navigation long ago. Caen is an example of a French provincial city which, while of no great size, is an active centre of cultural and intellectual life. Its university and museums are widely known, and architecturally the city is comparable with Rouen.

The approach from the English Channel leads through the banks lying off the Orne. The river outlet undergoes considerable changes from time to time, and charts soon become out of date. The roadstead is sheltered from south-east to south-west winds, and provides anchorage in depths of 6.9–11.9 m. (22.5–39 ft.). Access to the port is facilitated by the prolonged period of high water which is experienced along these shores. The channel leading to the canal is preserved in some degree by two parallel submerged dykes or jetties which restrain the movement of shoals. At the canal entrance, and opening away from the easterly dyke, two more parallel submerged dykes serve to keep open the mouth of the Orne, which flows into the sea 1.5 km. to the east, by constricting the current. The outflow of the river thus maintains some scouring action and thereby helps further to preserve the approach to the canal. Since 1906 suction dredgers have been employed to maintain depths, and about a quarter of a million cu.m. of sand are dredged annually.

The limits for entrance to the port are: maximum draught at high water 6.56 m. (21.5 ft.); length 100 m. (328 ft.); beam 17.5 m. (57.4 ft.). The entrance channel leading to the canal lock at Ouistreham is confined between two jetties 39 m. (128 ft.) apart, and has a depth of 7.9 m. (26 ft.) at M.H.W.S. and 5.7 m. (18.6 ft.) at M.H.W.N. The entrance lock is 181.0 m. (594 ft.) long and 18 m. (59 ft.) wide, with the sill 3 m. (9.5 ft.) above datum and a depth on the sill of 7.4 m. (24.25 ft.) at M.H.W.S. Above the lock the canal is widened so that vessels up to 90 m. (295 ft.) in length, and vessels up to 100.6 m. (330 ft.) with a draught no greater than 4 m. (13.1 ft.), can turn. The depths in the canal are maintained by a barrage across the Orne at Caen which was constructed in 1912. The governing width at the

Submerged jetties:

- a Western c Pointe  
b Eastern d Merville

ap Avant-Port

B Bassin d'Hérouville  
(former private port  
of the S.M.N.)

G Gare Ch Château

S Chantiers Navals  
Français Shipyard

St Steelworks (Soc.  
Métallurgique de  
Normandie)

— Narrow Gauge Railway

— Railways

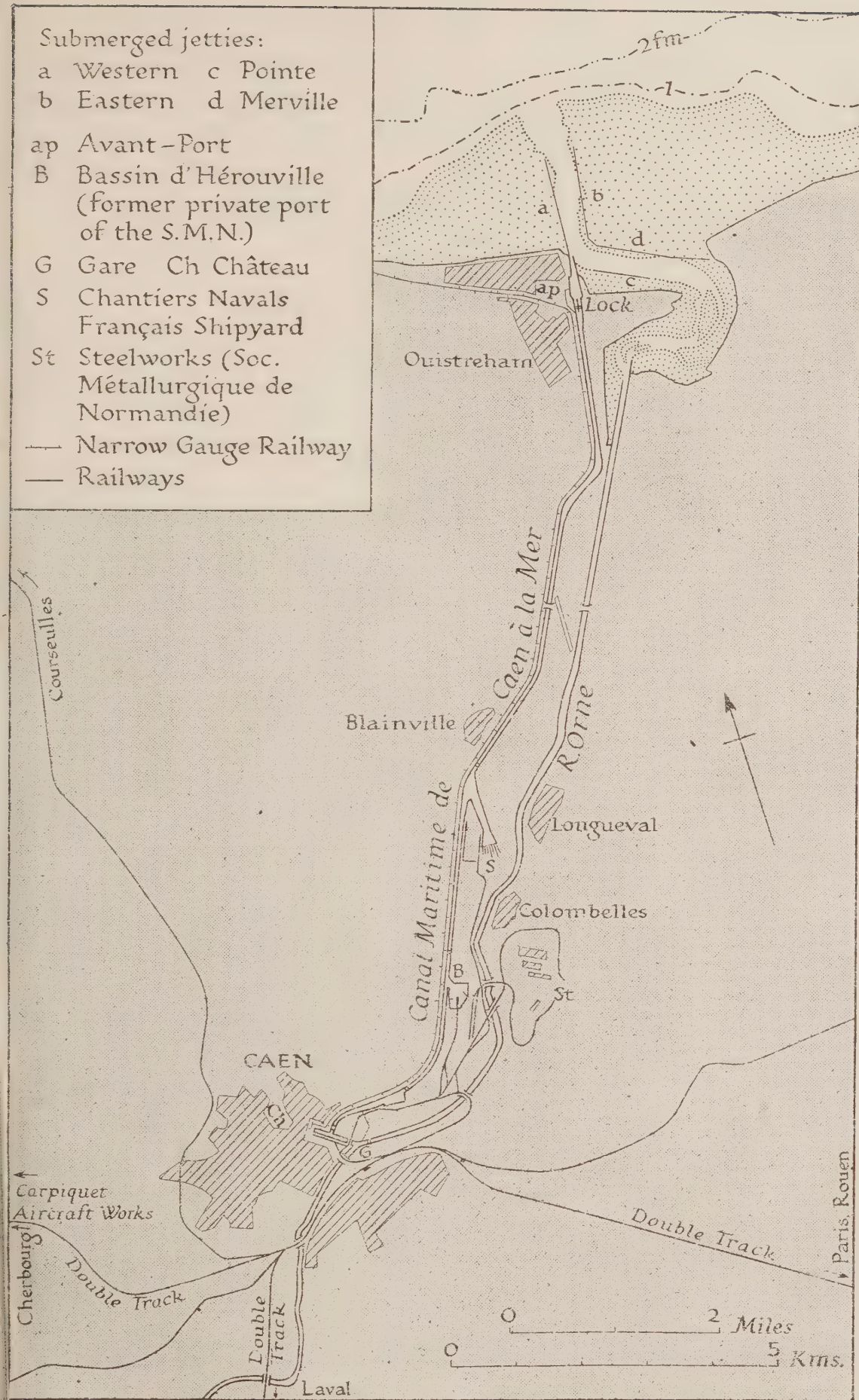


Fig. 16. Caen, Ouistreham and the Canal Maritime de Caen à la Mer



four bridges is 18 m. (59 ft.); the maximum dimensions of vessels normally using the canal are: length 80–90 m. (262·5–295·25 ft.), beam 12–13 m. (39·3–42·6 ft.), with a tonnage up to 3,000. The limiting factor seems to be the lock and entrance depths rather than the canal depths: vessels of 5,000–6,000 tons can get up to Caen, but they have to choose their tide. (See Plate 14.)

### *Detailed Description*

The docks of Caen consist of two older basins in the heart of the town and a new basin lower down the canal, while nearer to the sea are the Bassin d'Hérouville (formerly the private dock of the *Société Métallurgique de Normandie*) serving the iron and steel works, and the C.N.F. (*Chantiers Navals Français*) shipbuilding yard. The port has accommodation for thirty-five sea-going ships, distributed as follows:

Basin	Depth		Length of quays m.	No. of berths	Maximum length for vessels	
	m.	ft.			m.	ft.
Orne	3·5	11·5	300	4	54·8	180
St Pierre	5·18	17·0	1,134	14	80·0	262
Nouveau Bassin	6·56	21·5	1,085	13	100·0	328
Bassin d'Hérouville	5·8	19·0	150 (mole)	4	—	—
Chantiers Navals Français	5·64	18·5	—	—	—	—

The Orne basin is entered from the Vieux Bassin by a lock 40 m. (131 ft.) long and 12 m. (39·6 ft.) wide; the St Pierre basin is connected with the maritime canal by a passage 12·2 m. (40 ft.) wide. The Nouveau Bassin is simply an enlarged portion of the canal above Calix bridge, 61 m. (200 ft.) wide; it is planned eventually to widen the canal to 160 m. (525 ft.) as far as the port of the S.M.N. (Bassin d'Hérouville). Heavy traffic in the port has largely passed to the Nouveau Bassin and the Bassin d'Hérouville, which are better equipped for rapid loading and discharge. The older basins now handle less than 10 % of the port total. There are few warehouses, as the bulk of the merchandise handled does not require them. Storage grounds cover 13 ha. (see Plate 15).

### *Port Facilities*

The four basins of Caen are equipped with twenty-nine cranes of a capacity under 10 tons, and one 25-ton fixed electric crane. Some

of the cranes are fitted with grabs for mineral loading. The only underwater repairing equipment is a gridiron at Ouistreham, although the provision of a floating dock has been considered.

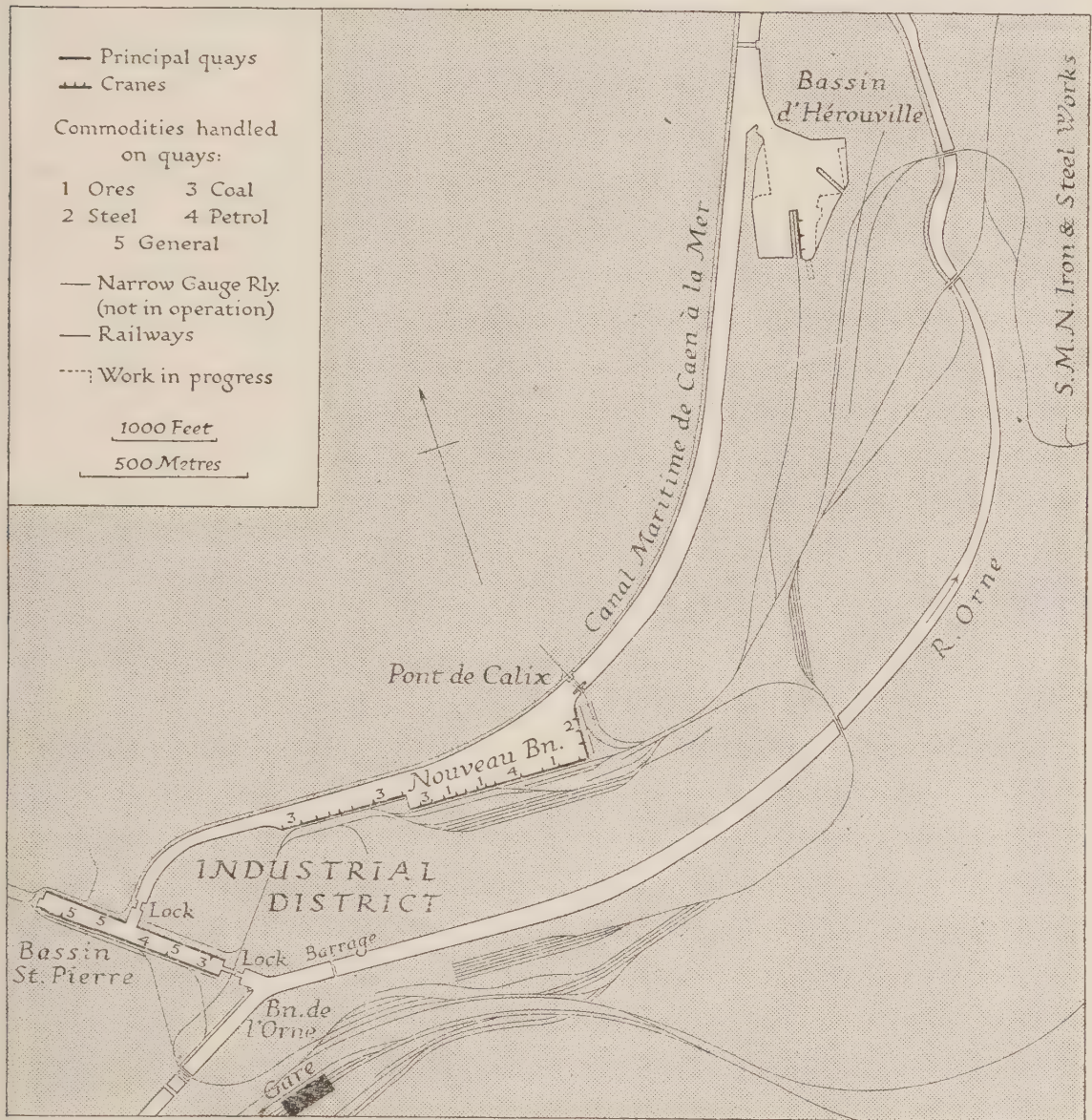


Fig. 17. Caen

## History

Caen first achieved importance in the eleventh century, for it was a favourite residence of William, the duke of Normandy who became William I of England in 1066. The export to England of the famous Caen building stone began at this time, and continued for centuries. In the Middle Ages, through its geographical position, the fortunes of Caen were closely involved in the various Anglo-French conflicts. Normandy remained an English possession until 1204, when the king



of France, Philippe Augustus, recovered it from King John, and thereafter it prospered until the Hundred Years War. In 1346 Edward III captured the city by a naval expedition, and looted it; eventually the English withdrew, but in 1417 Henry V captured it a second time after a fierce assault. Caen remained in English hands until 1450, and the latter part of this period saw some development of civic life under English rule, for in 1432 Henry VI founded the university.

As a port Caen became inaccessible even to medieval ships. The many meanders hampered navigation, and in 1531 under Francis I, the largest, the Longueval meander, was cut through, a work which improved navigation and mitigated floods. Prosperity was not lasting, however, and in the seventeenth and eighteenth centuries the port declined. The Revocation of the Edict of Nantes was a serious blow, for most of the commerce of Caen had been in Protestant hands. It was fortified by Vauban in 1705, but it played no important part in the naval wars of the eighteenth century. In the second French invasion scheme of 1797 it was one of the ports selected for the invasion flotilla, the others being Honfleur, Fécamp, St Valéry-en-Caux, Rouen, Calais, Ambleteuse and Etaples. In Napoleon's later scheme, in which the invasion flotilla was concentrated in larger masses in a smaller number of ports, Caen dropped out, and in the subsequent years of the war it was not used for naval operations.

Under the Directory, Baron Cachin, the great engineer of the works at Honfleur and Cherbourg, advised the abandonment of the Orne and the cutting of a canal. Work was started under the administration of Napoleon, but the canal completed in 1832 was not successful. An improved canal was opened in 1857; it was 15 km. long, 4 m. (13 ft.) deep, and was crossed by five swing bridges. It was accessible by vessels of only 300 tons, however, and three years later it was deepened to 4.5 m. (14.5 ft.), when the works at Ouistreham were completed. Later came a further deepening to 5.2 m. (17 ft.), and works were undertaken to secure the outer channel to the sea against the meanders of the Orne.

The first shipment of iron ore was made in 1875, and by 1900 the production amounted to 0.15 million tons, developments which were reflected in the opening of a new lock in 1903. An export in 1913 of 0.5 million tons demanded further expansion, and in 1914 the quays were lengthened and the railway facilities improved. Shortly after the war of 1914-18, the new basin and the metallurgical port were completed, while further quays were added. Since 1918 the

canal banks have been improved, and the curves enlarged so as to permit the passage of vessels up to 3,000 tons. Work was in progress in 1939 to improve the Bassin d'Hérouville, and to make it capable of serving its original function as port for the steel works, and thus releasing more of the accommodation at the Nouveau Bassin for general trade.

### Trade

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	1,240.3
Exports	788.7
Total	2,029.0
Coastwise trade (total)	147.8
Total sea-borne trade	2,176.8
Total foreign trade 1938 (provisional figures)	1,728.7

The imports and exports of Caen, unlike those of other French ports, are much less ill-balanced, for the ore and steel shipments provide a return freight for the vessels bringing coal, phosphates, etc., and make it the fifth exporting port in France. Much of the coal import is provided by Great Britain and Germany, the countries which take most of the iron and steel. Of the coal import 600,000 tons move to the Bn. d'Hérouville. Other imports consist of timber from Scandinavia, and manganese. There is some export of agricultural produce from the surrounding district, and a growing export of scrap iron. There is a considerable passenger traffic to Havre, amounting to as many as 12,000 passengers annually. Trade in general has been helped by the locally owned *Société Navale Caennaise*, which operates twelve vessels.

In miscellaneous trade Caen is not important, for it lies too close to the well-established port of Havre, and comes within its hinterland, although it is well placed for the import of coal for general consumption within a more limited hinterland. It is clearly the iron-ore export and the iron and steel industry which dominate its activity, and which will govern its future prospects. The Chamber of Commerce has sunk large capital sums in port development, and is thus closely identified with the future prosperity of the metallurgical and mining industry.

### Industries

The S.M.N., founded in 1915 by *Schneider-Creusot* and *Compagnie des Aciéries de la Marine et d'Homécourt* (St Chamond), continued



operation of the older works started by Cail and Thyssen; the first coke ovens were lit in 1916. Near the port are two blast furnaces, with an annual capacity of 360,000 tons of foundry iron, six batteries of forty-two ovens producing 0.5 million tons of coke, and plant for the treatment of by-products. Equipment includes a Thomas steel plant with three 30-ton retorts, Martin furnaces, a rolling mill, etc., all of which employ, in times of good trade, more than 4,000 workers. There is a 30 km. railway to reach the Soumont iron ore, which lies to the south-east, and a branch to the public line to allow the export of ore. The S.M.N. built a private port largely to handle imports of foreign coal. Half the manufactured products of the company are exported by the public port and the amount is normally increasing. In 1934, 0.158 million tons were exported out of a production of 0.260 million tons.

The C.N.F. shipbuilding yard began work in 1919. There are ten building slips: five of 120 m. (393 ft.) and five of 150 m. (492 ft.), opening into a basin 400 m. long and prolonged by a 600 m. channel to the canal above Blainville Bridge. These works have built 5,000-ton colliers, and 12,000-ton oil tankers, as well as many submarines, torpedo-boats, etc., for French and foreign navies, but have been closed since 1936 for want of orders.

An important new industry is represented by one of the nationalized aircraft factories, at Carpiquet. Minor industries are saw milling and the manufacture of clothing.

### *Communications*

The quays of the port are served by the Western Region of the S.N.C.F., and by a mineral line constructed in 1912 to reach the ore deposits at Soumont. There are also private lines operated by the S.M.N. There is no canal connexion with the hinterland, and the river Orne is of no value as a means of transport.

## CHERBOURG

(See Fig. 18; Plates 16, 17)

### *General Description*

Cherbourg (pop. 39,000) lies at the northern extremity of the Cotentin peninsula, which, jutting out into the Channel towards Portland, halves its width. The port is 371 km. by rail from Paris, but the journey takes only 4½ hr. despite the adverse gradients.

The Grande Rade, sheltered by its three breakwaters, covers



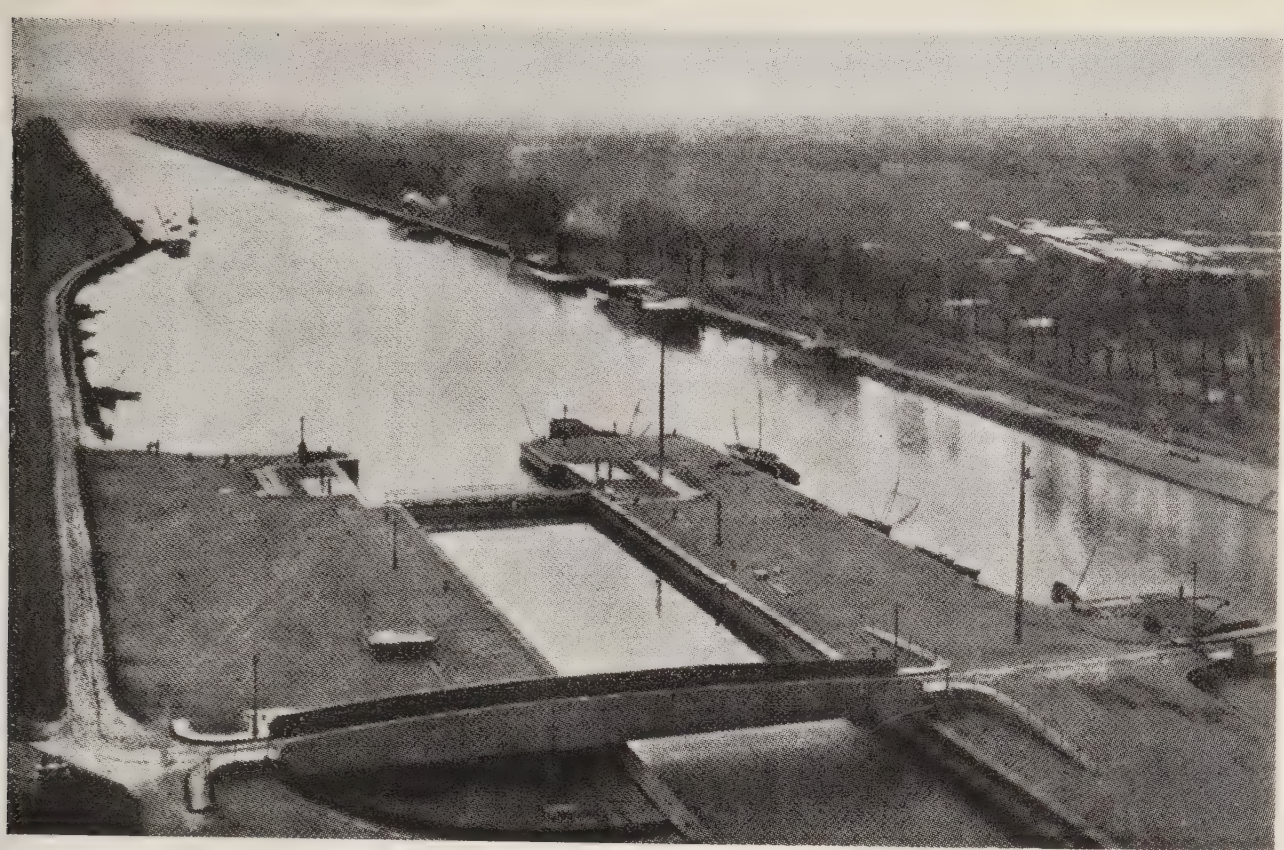


Plate 14. Ouistreham: entrance lock of the Canal Maritime de Caen à la Mer

This view, looking south towards Caen, is taken from the lighthouse. The lock now in use, the Nouvelle Ecluse, is in the foreground; the Ancienne Ecluse lies to the right of the picture. (For map see p. 67.)

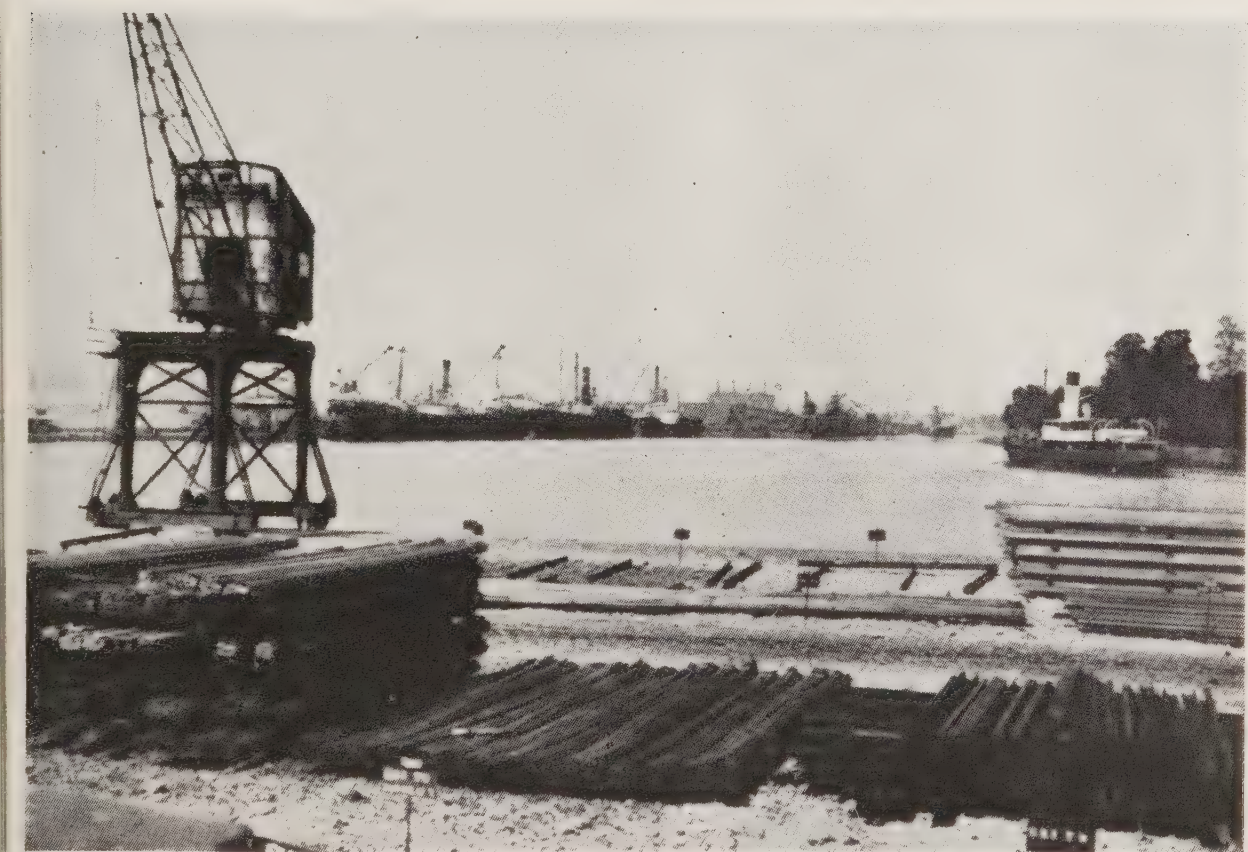


Plate 15. Caen: Nouveau Bassin (looking west towards the town)  
This basin forms the principal part of the port. (For map see p. 69.)





Plate 16. Cherbourg: the Gare Maritime (looking seawards)

To the right is the Quai de France with a liner alongside, while across the Darse Transatlantique can be seen the second mole under construction. Beyond the Petite Rade lie the Digue du Homet and the Jetée des Flamands, while in the distance can be seen the Digue Centrale of the outer breakwater. (For map see p. 74.)



Plate 17. Cherbourg: the Naval Base (looking south)

In the foreground is the Homet dry dock (the largest in the port), entered directly from the Petite Rade. From the Petite Rade on the left a wide entrance opens into the avant-port, which is connected further with the Bassin Charles X by a passage, and by another with the Bassin Napoléon III (to the right of the picture). At the south end of the avant-port can be seen a dry dock and four covered building slips. The other buildings form part of the shore establishment. (For map see p. 74.)



1,500 ha. and has a minimum depth of 12·8 m. (42 ft.). Of the two entrances, the westernmost is used by large vessels as it provides the requisite depth at all times; the eastern entrance, being shallower, is used by coasting vessels. This roadstead is a valuable harbour of refuge, protected on the south by an amphitheatre of hills. Within it lies the recently completed Petite Rade, or inner roadstead. The entrance to this roadstead between the Jetée des Flamands and the Digue du Homet is 500 m. wide. Transatlantic liners can anchor in the Petite Rade save at low-water spring tides. In the main roadstead there is a tidal stream up to 3 knots, with flood tides to the south-east and with ebbs to the north-west, while in the inner roadstead a current moves clockwise from the Commercial harbour to the Digue du Homet.

The main discharging point for petroleum, etc., at Cherbourg, lies in the western part of the Grande Rade, where the Querqueville breakwater is equipped with a discharging berth, allowing a draught of 10·0 m. (32 ft.). A pipe-line runs to the tanks and depot on the south-east of the town.

### *Detailed Description*

Within the Petite Rade lie what may be regarded as four separate harbours. To the west lies the naval base, which will not be described in detail here (see Fig. 18)—it consists of an avant-port and the Bassins Charles X and Napoléon III. To the south is the new deep-water Darse Transatlantique, with the avant-port and basin of the old commercial port nearby on the west. In the north-west of the roadstead are the quays of Homet in the angle formed by the Digue du Homet and the shore.

For large ships, the maximum draught obtainable in the port is 12 m. (39·3 ft.), which is to be found only in the liner dock and approaches.

*Darse Transatlantique or Liner Port.* The Quai de France, alongside which stands the new Gare Maritime, provides two berths with 12 m. (39·5 ft.) depth and two berths with 11 m. (36 ft.) depth along its 620 m. of quay. The Quai de Normandie on the opposite side of the dock is as yet unfinished but provides two berths with depths of 9 m. (29·5 ft.) along 300 m. of quay. The dock between the two moles is 228 m. wide. The entire liner dock is equipped with elaborate gear for the rapid landing of passengers and baggage, including thirteen travelling gangways, and there are twenty tenders. The west



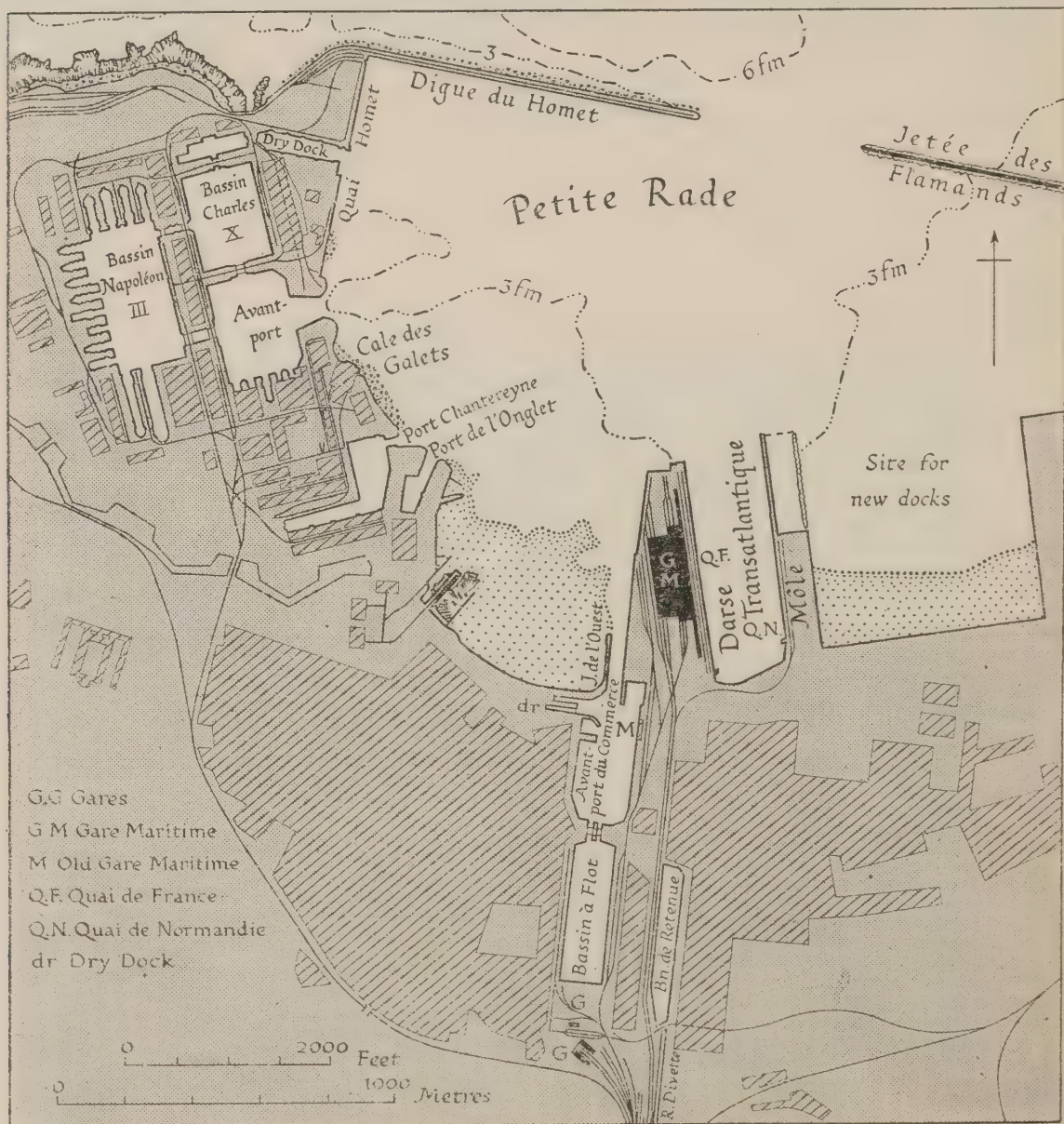
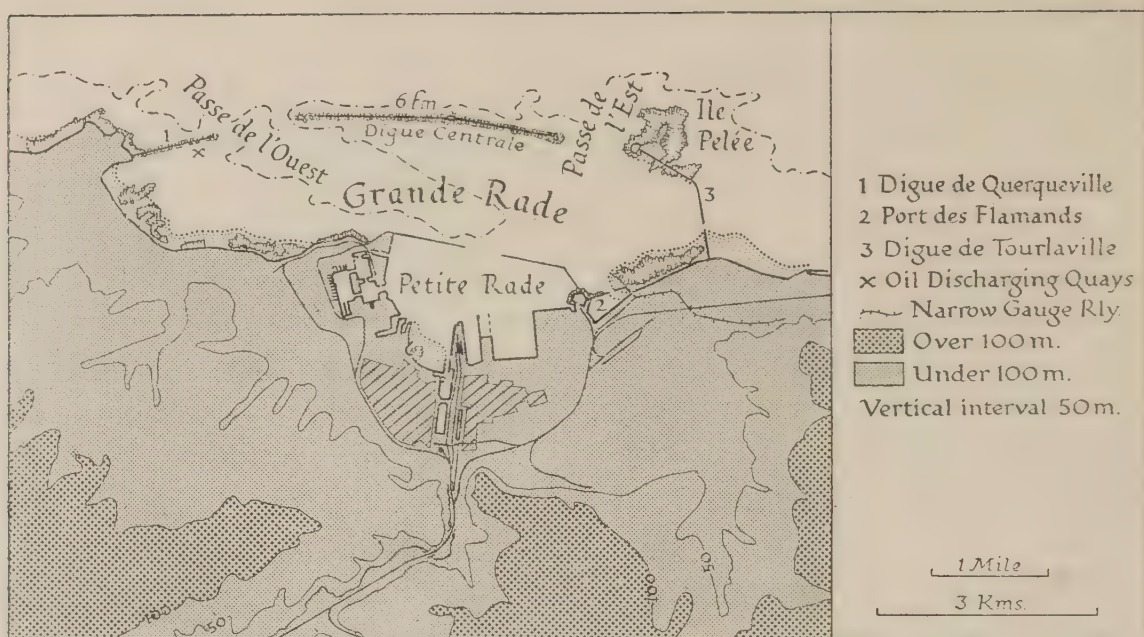


Fig. 18. Cherbourg

side of the principal mole is used only by tenders, and is dredged to 5 m. (16.5 ft.).

*The old commercial port* consists of an avant-port leading to the Bassin à Flot. The avant-port covers 6 ha.; its west quay is reserved for fishing boats, and its east quay for the coasting trade and the Southampton service. It is a relatively shallow tidal harbour, and its 630 m. of quays provide four berths at a draught of only 3 m. (10 ft.).

The wet dock, approached through the avant-port, is used for coal and miscellaneous cargoes. It is 400 m. long and 125 m. wide, and covers 5 ha. The 990 m. of quays provide seven berths on a draught of 5.2 m. (17 ft.). Entry from the avant-port is by a dock gate which limits the width of vessels to 15 m. (49.5 ft.), although there is no limit on length. The old lock east of this gate is no longer used.

*The Port of Homet*, in the inner roadstead, is well protected by the Digue du Homet, which here is 20 m. wide. Vessels of 8 m. (26.2 ft.) draught can be accommodated at all tides. The inner side of this breakwater-mole is a quay for heavy goods with three berths, shed equipment, three railway tracks on the quay, and a bunker coal depot. At the landward end there is a depth of 10 m. (32 ft.) on a berth 20 m. wide.

### *Port Facilities*

Lifting equipment consists of five floating cranes under 10 tons capacity; there are also a 15-ton travelling crane and a 100-ton floating crane. Cargo is discharged on the quays or directly into railway trucks or lorries. Lighters are practically never used, but in case of necessity can be hired from the navy. Generally there is no detention owing to shortage of berths. The old Marine station is now used for warehousing, and a large warehouse is situated on the eastern quay of the Bassin du Commerce. The commercial harbours are equipped with only one dry dock, 80 m. (262.4 ft.) long; this dock lies in the avant-port. The naval base is equipped with nine dry docks—seven in the basins and two outside, one of which is the largest in the port, having a length of 250 m. (820 ft.) and a width of 36 m. (118 ft.), while there is also a small floating dock with a lifting capacity of 350 tons.

### *History*

The earliest works date from the thirteenth century, while others were initiated by Vauban in the seventeenth century, but these struc-



tures, together with the walls of the town, were destroyed by order of Louvois in 1688. During the wars of Louis XIV, in 1692, the Anglo-Dutch fleets were off Cherbourg when they met Tourville in the engagement which ended in the French defeat at La Hogue. The real creation of the port, however, dates from 1738, when construction of a harbour commenced, with two jetties, a lock and a wet basin for both naval and commercial purposes. Shortly afterwards, in 1758, these works were destroyed when an English expedition sent by Pitt ravaged the town and burnt the shipping, and reconstruction was not completed until 1789. By then, however, an important decision for the future of Cherbourg had been taken, and it had been decided to build the Digue Centrale, 3,750 m. long, to protect the roadstead on the north. This work, immense for the resources of the period, was commenced in 1783, and finished in 1853 despite natural obstacles and interference by wars. Cherbourg played no great part in naval activities during the Napoleonic wars; although it was at this time that the naval base was constructed on the western shore of the bay, the basins being excavated to a depth of over 15 m. in the slate rocks. The avant-port and the first basin were finished in 1829, but the second basin was not completed until 1858. The first Atlantic liner visited the Rade in 1869. Many alterations to the naval base were made during the remainder of the nineteenth century, but no new basin was built. The developments initiated by Napoleon III, in creating a powerful naval base in the Channel, caused great uneasiness in England. In 1890 the defence authorities completed the Grande Rade by constructing two breakwaters running out from the mainland—Querqueville to the west, and Tourlaville to the east. During the war of 1914–18 Cherbourg was an important base port for both the British and American forces.

In response to the development of the transatlantic passenger trade extensive works of improvement were undertaken in 1923. The first step in the creation of the Petite Rade had been taken only a short time before, when the western breakwater, the Digue du Homet, was completed in 1913. The new works consisted of (i) the construction of a second inner breakwater, the Jetée des Flamands, which protects the harbour to the north-east, and (ii) the provision of deep-water docks at Mielles, to the east of the existing commercial harbour. The new liner mole, eastwards of the east jetty of the old Avant-port du Commerce, formed the western side of the deep-water Darse Transatlantique. The Gare Maritime on the mole was completed in 1933, and by 1937 the Quai de France was able to receive

the largest liners alongside. It was laid out so as to provide a quick passage from ship to train. The second mole is still under construction; the greater part of the western quay (Quai de Normandie) and the landward end of the mole are completed, but the core remains to be filled in. These works at Mielles are designed to provide eventually two more docks 600 m. long and 160–230 m. wide. In the 1940 operations Cherbourg played a prominent part in the evacuation of the Allied forces from France to England.

### *Trade*

Cherbourg is the greatest transatlantic passenger port of France, the traffic being easily handled by the new maritime station.

#### *Travellers to and from Europe and America passing through Cherbourg (thousands)*

1927	197	1932	83
1928	187	1933	53
1929	100	1934	42
1930	175	1935	67
1931	121	1936	85

The number of first-class passengers declined greatly during the period of depression, and there was consequently a very serious loss to revenue. Dock revenue fell from an average in 1927–9 of 14·5 million francs, to 8·3 in 1931, 5·5 in 1932, and 3·0 in 1934. Regular calls are made by French liners and by a number belonging to the leading foreign companies—Cunard White Star, Norddeutscher Lloyd, Hamburg America, Royal Mail, and Canadian Pacific.

From its nature as a passenger ‘pier-head’ port, far from any densely peopled inland industrial centre, Cherbourg cannot handle any great amount of trade.

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	155·3
Exports	72·6
Total	227·9
Coastwise trade (total)	97·3
Total sea-borne trade	325·1
Total foreign trade 1938 (provisional figures)	245·5

The goods discharged include stores for the arsenal, coal, cement, petroleum, etc., fertilizers from Dunkirk, grains, Scandinavian wood, and coffee and spices, etc., from Havre. Exports form up to 30 %



of the trade, the greater part comprising granite and macadam for roads, as well as a certain amount of early vegetables and dairy produce. The dock extensions undertaken in the period of prosperity mean that the port will be able to deal with any conceivable increase in the passenger trade. Sites for industrial undertakings will become available, for dredged material has been dumped between the second liner mole and the root of the *Jetée des Flamands*, thus creating extensive areas of flat ground. If new factories should be established, the port will be well able to deal with the resulting cargo trade. Beyond a Schneider engineering plant and a factory making agricultural machinery there are few industries. The arsenal specializes in the construction and repair of submarines.

### *Communications*

Situated at the end of a narrow peninsula, Cherbourg has no large river or canal connecting it with the interior, so that the railway is essential for the limited trade of the port. For the first 10 km. the line to Paris ascends a heavy gradient which necessitates the use of very powerful locomotives for the working of the long trains which run in co-operation with the liner services. (See p. 309; plate 69.)

## ST MALO-ST SERVAN

(See Fig. 19; Plate 18)

### *General Description*

St Malo (pop. 13,000) is an important centre for cross-Channel and tourist traffic, and the commercial port for a hinterland embracing central Brittany. It lies at the mouth of the river Rance, off the right bank, in a rock-studded bay. Several channels lead into the Rade de St Malo—in the main channel the least depth is 4.9 m. (16 ft.) in the fairway, while a secondary channel has 4.0 m. (13.1 ft.). There are several minor entries, but these are difficult for navigation. The roadstead is used only by vessels waiting to enter the port; there are other anchorages towards Dinard, the town on the opposite side of the Rance, and in the estuary of the Rance. The tidal range is considerable, and the approach channel is left almost dry at low water, so that passengers have either to wait or to land in *vedettes*.

### *Detailed Description*

The port consists of an avant-port, the three basins of Vauban, Duguay-Trouin (St Malo) and Bouvet (St Servan), and the interior

basin or Mare aux Canards. It can admit vessels up to 160 m. (525 ft.) length, 25 m. (82 ft.) beam, and 9.6 m. (31.5 ft.) draught at highest tides. The outer port, with an area of 18 ha., is sheltered by the Noires mole, which extends to the south-west, and was recently lengthened to 574 m. This avant-port dries save for a channel leading to the main lock dredged to 1.8 m. (6 ft.) and the Vedettes channel to the Cale de Dinan near the tram terminus, where the Dinard and Dinan boats dock.

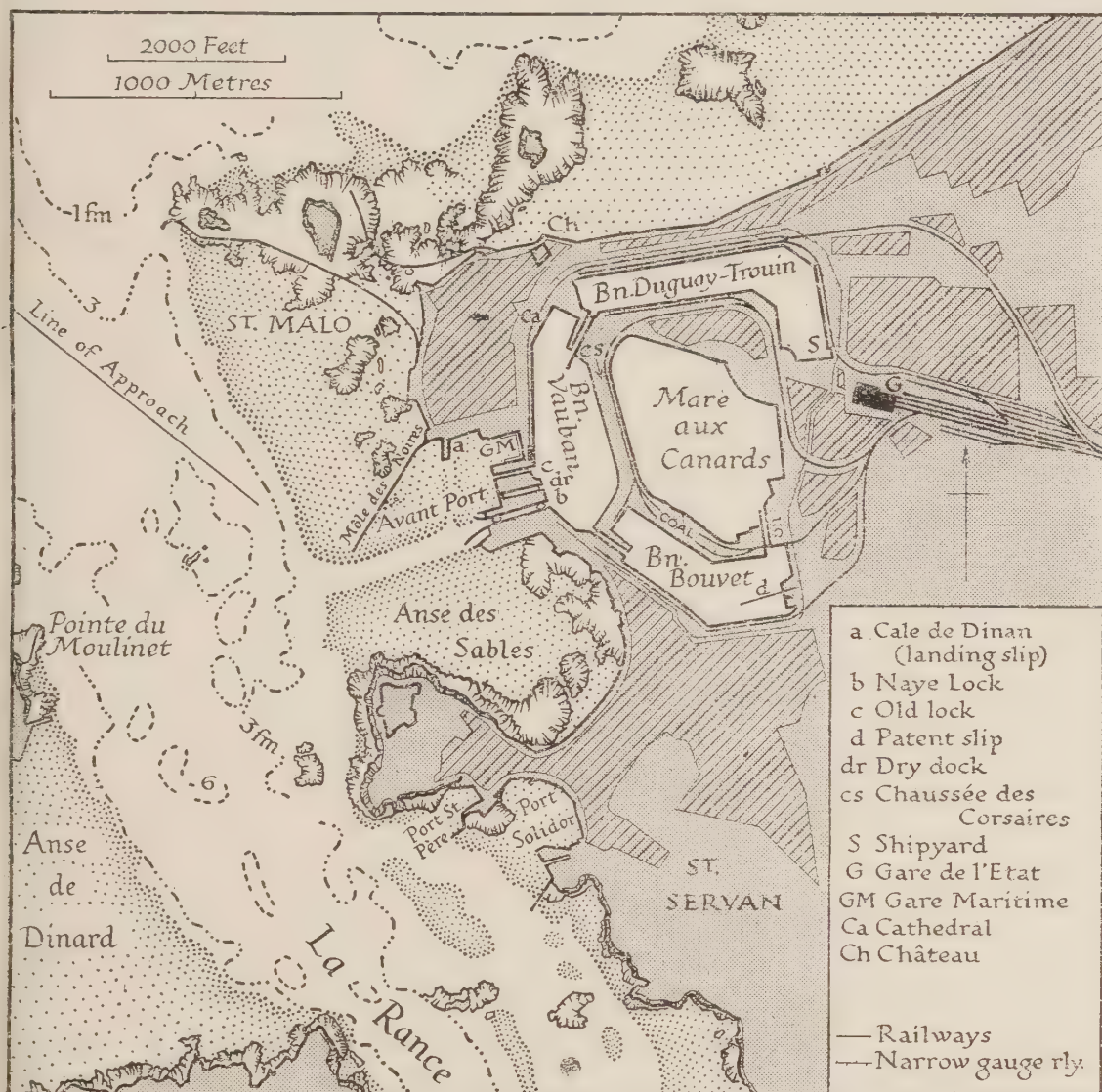


Fig. 19. St Malo-St Servan

St Malo stands on a coast with the greatest tidal range in France, and at the port itself the maximum range is 13.5 m. (44.3 ft.). At low water the approach is dry, but at high water the level outside stands higher than the level inside the basins, so that the pressure of water is exerted in opposite directions according to the state of the



tide. Hence two sets of lock gates are necessary, one set pointing towards the sea and one towards the basins. This arrangement normally allowed the locks to be used at any state of the tide provided that there was a suitable depth of water in the approach.

There are fifty berths in the port for vessels, of varying dimensions:

Basin	Quay	No. of berths	Depth M.H.W.N.		Depth M.H.W.S.		Length of berth m.
			m.	ft.	m.	ft.	
Vauban	de la Bourse	1	6.25	20.5	7.75	25.3	130
	Others	7	4.75	15.6	6.25	20.5	86-110
Duguay-Trouin	Sud-Est	2	4.25	13.9	6.25	20.5	50
	Others	21	5.75	18.8	7.25	23.8	68-120
	Pourquoi Pas, W. and N.	8	5.4	17.7	6.8	22.3	77-105
	Naye	3	4.25	13.9	5.75	18.8	50
Bouvet	Trichet du Val	8	4.1	13.4	5.6	18.4	50-56

The total length of quays is 4060 m.

Although the Vauban basin is quayed, vessels cannot lie along the eastern side. The Duguay-Trouin basin is 890 m. long and 122 m. wide; the bottom is 3.4 m. (11 ft.) above datum, and the water level in it is never allowed to rise beyond 11.6 m. (38 ft.) above the datum. The foundations of the quays project about 3.4 m. (11 ft.). The Bouvet basin is 600 m. long and 200 m. wide; the bottom alongside the quays is from 4.6 to 6.1 m. (15-20 ft.) above the datum, and the water level in the basin is never allowed to rise beyond 11.6 m. (38 ft.) above the datum. At the inner end is a coffer dam 4.6 m. (15 ft.) above datum; a passage leads from this basin to the Mare aux Canards or Bassin Intérieur.

### *Port Facilities*

The equipment of the port includes thirty-one steam cranes up to 5 tons which can discharge coal at a rate of up to 5,000 tons in 8 hr., and three other cranes of 3, 15, and 15 tons. There are 31,000 sq.m. of sheds. Small repairs can be executed and the port maintains lighters and a tug. There is a slip with a lifting capacity of 500 tons, and a dry dock near the Naye Lock 133 m. (436 ft.) long and 18 m. (59 ft.) wide, with a depth on the sill of 7.5 m. (24.5 ft.).

### *History*

The history of St Malo epitomizes the maritime history of France. The earliest settlement in the neighbourhood was at St Servan, 1 km. to the south on the mainland proper. As a result of the raids

of the Norman pirates, the inhabitants of St Servan took refuge on the granite platform to the north which was virtually an island, and connected with the mainland only by a narrow isthmus. In the twelfth century the bishop of the mainland see moved to the island, which thenceforward took the name of St Malo, and built a cathedral there. The advantages of the new site were soon realized by fishermen and merchants. A prominent feature of the town's history in succeeding centuries was the struggle to maintain its independence against the dukes of Brittany, but a more stirring story is that of the part played by the men of St Malo in the Hundred Years War. In 1378 it was attacked by the duke of Lancaster but held out until relieved. In 1406, a captain of St Malo, Tanneguy du Châtel, raided Yarmouth and effectively looted the town, after being driven off the year before. In 1453 forces from the town effected a miraculous deliverance of Mont St Michel, which was on the point of falling to the English besiegers. Privateers from St Malo harried the merchant ships of the English throughout the hostilities.

A period of considerable prosperity followed the discovery of North America and the Banks of Newfoundland, and the fishing activity which rapidly developed at that time has remained important ever since. It was from St Malo that Cartier sailed to explore the St Lawrence and to lay the foundations of the French colony in Canada. The seventeenth century was its great era of expansion. The shipowners fitted out squadrons which reinforced the royal fleets during the siege of La Rochelle; their vessels, led by the famous Duguay-Trouin, preyed upon English shipping, and money from their prizes made the fortunes of the town. Vauban proposed a series of works to improve the port, but the people of St Malo were loath to take any steps which they thought would benefit St Servan. In the Anglo-French wars the sailors of St Malo continued to play a prominent part. In 1668 Louis XIV ordered that the flagship of his fleet should be manned exclusively by sailors, officers and gunners from St Malo. The English attempted to destroy the town from the sea several times, especially in 1693 and 1695. In 1695 a portion of the fleet which escaped from the English victory at La Hogue took refuge in St Malo and its capture was considered, but time was lost and the opportunity passed. In June 1758 an expedition of about 13,000 men was sent by Pitt as a diversion to relieve the pressure on the army in Hanover. The troops were landed in Cancale bay and marched across the peninsula to St Servan. The yards and storehouses were burnt together with four large ships of war, seventy-



four merchantmen and eight large privateers, an operation which gave a great measure of protection to English trade. After the attack on Cherbourg in August (see p. 76) the army which had burnt the shipping there made a second attack on St Malo with 7,000 men. The landing was made at St Lunaire, to the west of the town, but the operation was interrupted by bad weather. Re-embarkation on a lee shore was impracticable and the troops were marched round to St Cast. During the embarkation a superior enemy group attacked the force which lost about 1,000 men. During the Napoleonic wars the famous Surcouf led privateering raids on English shipping, but they were not on the scale of the raids of a century before. During all this period men from St Malo were active in exploration and treasure hunting in the Americas, and in colonial enterprises. De la Barbinais, the first Frenchman to sail round the world, was a native of St Malo.

The wars, however, caused a falling off in trade, and with the opening of the more peaceful period after 1815 the history of the port became largely one of dock construction. The demand for a wet dock grew, and most proposals envisaged a barrage from St Malo southwards to the Naye rocks, entered by a lock. The barrage and the natural isthmus to the north would virtually create a large basin. Local opposition, however, arising chiefly from the rivalry between St Malo and St Servan, prevented the main plan from being realized. Basins were constructed piecemeal—that of St Servan in 1884 and that of St Malo in 1885, approached from either side of an avant-port. A dyke between the two enclosed a central reservoir, which for many years now has been used as a winter harbour for the *Terreneuviers*, the Newfoundland fishing boats.

An improvement scheme sanctioned in 1919, and now complete in its essentials, was the fulfilment both of the early nineteenth-century plans and of Vauban's proposals. The old Bourse passage between St Malo and Naye rocks was closed by a barrage which was pierced by the Naye Lock. With the opening of this lock in 1933 the former tidal harbour became the Bassin Vauban. Further works planned are the extensions of the outer mole and the construction of a new mole to the south so as to improve the access for large ships, the construction of a deep-water quay along the Chaussée des Corsaires, and the development of quays in the Bassin Intérieur.

*Trade**Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	414.3
Exports	68.1
Total	482.4
Coastwise trade (total)	62.3
Total sea-borne trade	544.7
Total foreign trade 1938 (provisional figures)	438.6

The principal import is coal, dispatched coastwise to the northern parts of Brittany and inland as far as Rennes. In 1919 this import amounted to 646,000 tons, but since then has fallen to about a third of the figure. England supplies the greater part, but smaller quantities come from Germany, and from northern France (via Dunkirk). Salt, fertilizers, salt fish and timber make up the bulk of the remaining imports. Exports are almost entirely fruit and vegetables from Brittany and farther south, mainly to England, with some quantity of pit props. In some years potatoes have amounted to 50,000 tons, or half of the total export. The vegetable trade is aided by the regular ferry steamship service to Southampton. The tourist traffic brings considerable business to the town, and in some years the number of passengers has exceeded 100,000. Fishing is an important activity, and about 140 vessels are engaged in the near and distant grounds. There is a small shipbuilding industry.

*Communications*

There are 14 km. of railway in the port. The line southwards to Rennes and Nantes, together with the cross-Channel service, gives St Malo a certain amount of importance in through communications. The Côte Emeraud-Pyrénées express runs via Nantes and Bordeaux to Hendaye. The maritime station is leased to the Southern Railway. A narrow-gauge steam railway connects the town with Cancale to the east, on the Baie de Mont St Michel, and another runs as far as Rennes, 79 km. away. Small vessels provide services for goods and passengers to Dinard on the opposite shore of the estuary.

## MINOR CHANNEL PORTS

Many small ports are situated along the Channel coast, and though few of them carry on any extensive trade, a considerable tonnage of cargo in the aggregate passes through them.



*Gravelines* (pop. 1,800) lies on the river Aa, 1·5 km. from the sea. There is a tidal harbour with four quays 370 m. in length, and a basin with three quays 400 m. in length. The depth in the channel is 4·8 m. (15·7 ft.) at M.H.W.N. and 6·1 m. (20 ft.) at M.H.W.S. The channel, avant-port and Port d'Echouage provide a depth along the quays of 3·8 m. (12·4 ft.) at M.H.W.N. and 5·1 m. (16·7 ft.) at M.H.W.S. The quays have three berths for ships up to 40 m. (131 ft.) in length and four for ships up to 70 m. (230 ft.). The Bassin Vauban is entered by a lock which has a depth on the sill of 4·2 m. (14 ft.) at M.H.W.N.; depths along the quays are 3·2–4·5 m. (14·8–19 ft.) at M.H.W.N. and 4·5–5·8 m. (14·8–19 ft.) at M.H.W.S. These quays provide five berths for ships up to 70 m. (230 ft.) in length. There are seven cranes up to 2 tons capacity on the quays and three pontoon cranes up to 4 tons. The trade consists largely of an import of coal.

*Trade of the Minor Channel Ports*

	No. of ships entered and cleared	Foreign trade Thousands of tons				Coastwise trade Thousands of tons		
		Net tonnage	Imports	Exports	Total cargo	In-wards	Out-wards	Total cargo
Gravelines	747	87·4	68·3	2·8	71·1	0·2	—	0·2
St Valéry-sur-Somme	16	3·2	—	5·0	5·0	1·9	3·0	3·9
Abbeville	3	0·4	0·5	—	0·9	3·5	3·3	6·8
Le Tréport	235	93·6	82·8	18·1	100·9	—	—	—
St Valéry-en-Caux	13	2·1	0·2	3·0	3·2	—	—	—
Fécamp	264	133·7	82·3	11·5	93·8	8·3	0·7	9·1
Honfleur (including Quillebeuf)	295	141·1	142·8	5·1	147·9	18·0	16·2	34·2
Trouville-Deauville	189	76·9	83·4	10·0	93·4	12·5	1·9	14·4
Courseulles	15	4·2	5·5	—	5·5	1·3	—	1·3
Port-en-Bessin	15	2·3	2·9	1·2	4·1	0·3	—	0·3
Isigny-sur-Mer	19	4·4	5·0	0·6	5·6	0·3	—	0·3
Carentan (included under Cherbourg)								
Granville	211	114·9	81·0	78·8	159·8	21·9	5·0	26·9
Le Légué	306	72·4	86·0	2·4	88·4	33·6	6·2	39·8
Paimpol	114	18·9	17·8	0·7	18·5	23·7	11·5	35·2
Tréguier	47	7·9	9·1	—	9·1	4·0	16·3	20·3
Lannion	49	8·5	9·5	0·5	10·0	2·9	1·0	4·0
Morlaix	143	31·8	37·3	1·1	38·4	16·1	7·3	23·4
Roscoff	171	24·3	4·6	10·2	14·8	0·5	0·1	0·6
Total		828·0			870·4			220·7

*St Valéry-sur-Somme* (pop. 2,700), on the estuary of the Somme, can normally receive vessels up to a maximum length of 60 m. (197 ft.) on a draught of 3·5 m. (11·5 ft.) at M.H.W.N. There are nine berths, six at the 395 m. of quay and three at three small landing stages.

The harbour dries and there is no basin, but a lock affords communications with the Canal de la Somme, where boats can remain afloat. There is one 2-ton crane. Very few sea-going ships use this port, either in the coasting or the foreign trade, although several authorities devote some attention to it.

*Abbeville* (pop. 19,000) lies 15 km. farther up the Somme. It receives a few small vessels annually, but is concerned mainly with coasting trade. The port lies on the northern bank of the canal.

*Le Tréport* (pop. 4,700) lies at the mouth of the river Bresle. The port can be entered by vessels up to 100 m. (328 ft.) in length, and drawing 4·8 m. (15·7 ft.) at M.H.W.N. and 6·8 m. (26·6 ft.) at M.H.W.S. The avant-port provides three berths with a normal draught of 4·3 m. (14 ft.) and the Bassin à Flot eight berths up to a draught of 5·5 m. (18 ft.). On the 726 m. of quays there are thirteen cranes up to a capacity of 5 tons and one 7-ton travelling crane.

*St Valéry-en-Caux* (pop. 2,300) is visited by a few ships annually. The port consists of an avant-port and a wet dock and can admit vessels up to 70 m. (230 ft.) in length. The draught depends upon the state of the bottom at the entrance which was badly silted in 1939.

*Fécamp* (pop. 16,500), lies at the mouth of two small streams near the western end of the Pays de Caux. Entrance to the port is possible on a draught of 6·0 m. (19·7 ft.) at H.W.L.N., 6·5 m. (21·3 ft.) at M.H.W.N., and 9·0 m. (29·5 ft.) at M.H.W.S. The maximum length admitted is 105·0 m. (344·5 ft.) and beam 16·0 m. (52·5 ft.). There are three basins in the port, providing accommodation as follows:

	Draught, M.H.W.N.		Berths
	m.	ft.	
Bassin de Mi-Marée	6·5	21·3	2
Bassin Freycinet: Quays	6·0	19·7	5
Wharves	5·0	16·5	—
Bassin Bérigny	5·0	16·5	8

Length of vessels limited to 70–80 m. (229·6–262·5 ft.).

The quays are 1620 m. in length and are equipped with four 3-ton electric cranes and one 5-ton hand crane, while there is also one 20-ton pontoon crane. The foreign trade is chiefly in coal.

*Honfleur* (pop. 7,700) lies on the south side of the Seine estuary, about 7 km. from the open sea. For statistical purposes the traffic of Quillebeuf, 15 km. farther up the Seine, is included under Hon-



fleur. The port consists of four basins and can accommodate vessels up to 110 m. (360·9 ft.). Vessels with a draught of 4·9 m. (16 ft.) can enter at M.H.W.N. and 5·6 m. (18·5 ft.) at M.H.W.S. Bassin de l'Ouest and Bassin du Centre are the older basins of the port. In the Bassin de l'Est there are seven berths on a draught of 3·9 m. (12·8 ft.) at M.H.W.N., and in the Bassin Carnot there are eleven berths on a draught of 3·0–3·5 m. (10–11·5 ft.). The 1525 m. of quays are equipped with eleven cranes up to 5 tons capacity, and there is a pontoon crane of 8–12 tons. The foreign trade consists almost entirely of imports; there is also a considerable coastwise traffic.

*Trouville-Deauville* (pop. 5,500) is 7 km. westwards, at the mouth of the La Touques river. The Bassin Morny provides eight berths for vessels up to a length of 90 m. (295 ft.) and drawing 3·6 m. (11·8 ft.) at M.H.W.N. The 680 m. of quays in this basin are equipped with five cranes up to 5 tons. There is also a yacht basin. Trade, both sea-borne and coastwise, consists largely of imports.

Westward along the coast of Normandy to the Cotentin peninsula are three very small ports, *Courseulles-sur-Mer* (pop. 1,200), *Port-en-Bessin* (pop. 1,500) and *Isigny-sur-Mer* (pop. 2,100), which are used by a small number of ships. The harbour of Courseulles consists of an avant-port and a wet dock, and can accommodate vessels drawing 4·0 m. (13 ft.) at M.H.W.S. At Port-en-Bessin there are an avant-port and two small basins which dry. Isigny-sur-Mer lies 3 km. inland on the l'Aure river; its harbour dries, but can accommodate vessels drawing 4·0 m. (13 ft.). A short distance to the west of Isigny is the small port of *Carentan* (pop. 3,200), 8·5 km. from the sea. It lies near the confluence of the De Taute and De Douves rivers, which enter the sea at the head of the bay formed by the eastern shore of the Cotentin peninsula. A canal, which dries at low tide, leads to a wet dock in which depths vary from 4·6 m. (15 ft.) to 3·0 m. (10 ft.). The entrance lock is 36·5 m. (121 ft.) long with a sill 1·8 m. (6 ft.) above chart datum. Vessels with a length approaching that of the lock can enter only at very high water. For purposes of trade returns Carentan is regarded as an annexe of Cherbourg.

*Diélette*, on the western coast of the Cotentin peninsula, about 20 km. south of Cap de la Hague, is a small port at which iron ore is sometimes loaded. The berth is provided by a 2000-ton caisson.

*Granville* (pop. 10,000) serves the region lying between St Malo and Cherbourg. A lock gives access to a wet dock, and limits the length of vessels to 100 m. (328 ft.). The basin provides seven berths





Plate 18. St Malo-St Servan (looking south-west)

In the foreground is the oldest part of the town, built on a rock island. Behind lies the Naye lock, with curved guiding jetties at its entrance, giving access to the Bassin Vauban and so to the interior basins. The Southampton steamer is moored near the Gare Maritime, inside the Bassin Vauban, near the lock. (For map see p. 79.)

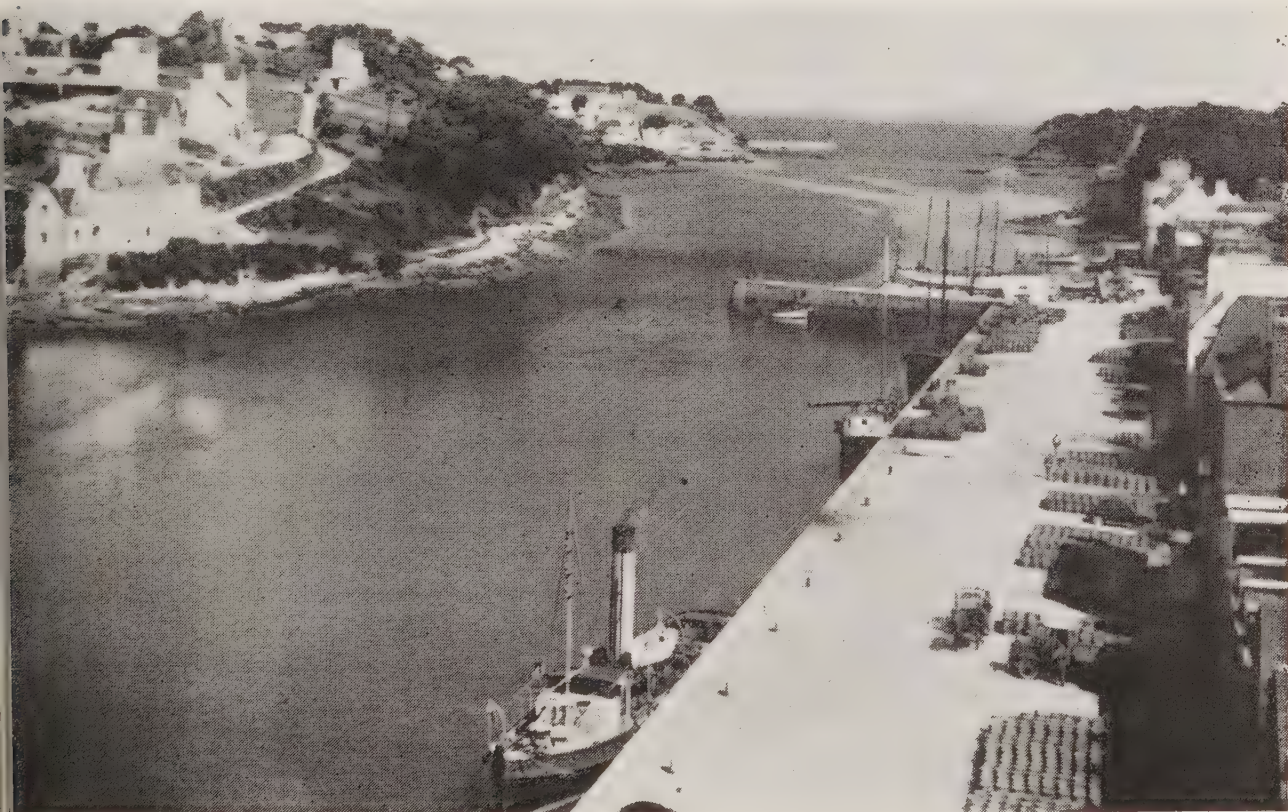


Plate 19. Douarnenez: the inner harbour of Port Rhu (looking north)

This small port stands on the south shore of the Rade de Douarnenez, south of Brest. It is an important fishing and fish-preserving centre. The harbour illustrated dries completely at low water; the vessels are moored alongside the Grand Quai. On the horizon lies the Presqu'île de Crozon. (For map see p. 89.)





Plate 20. Brest: the Pont National (looking south-west towards the roadstead)

This high-level swing bridge is the lowest of the bridges which cross the *Port Militaire* except for a floating foot bridge, hidden in the view, behind the Pont National. (For map see p. 92.)

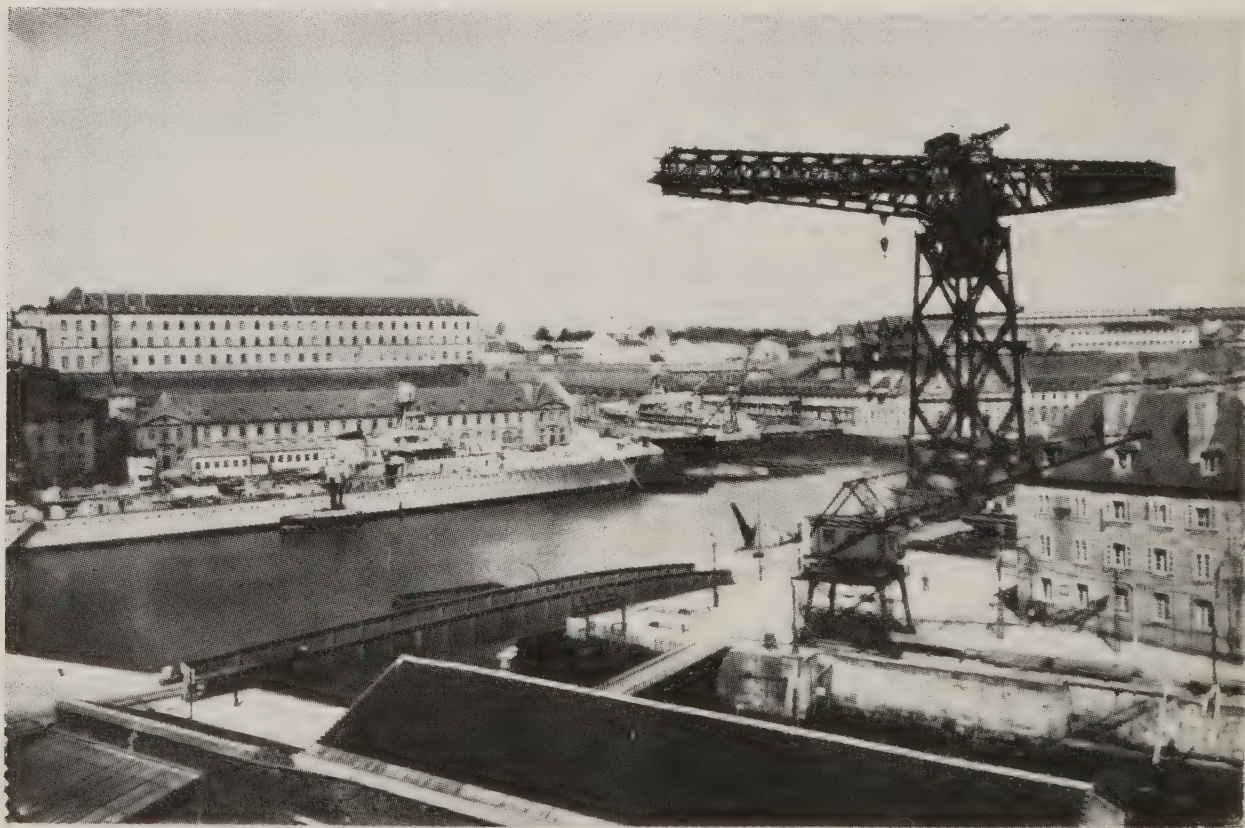


Plate 21. Brest: the 150-ton hammerhead crane in the naval port (looking north)

In the foreground is No. 1 dry dock, while across the Penfeld River are dry docks Nos. 2 and 3. To the left of these two docks is a barracks building and to the right are large machine shops. (For map see p. 92.)



on a draught of 5.0 m. (16.5 ft.); the 780 m. of quays are equipped with five electric cranes (three 7-ton and two 3.5-ton) and four steam cranes (two 3-ton and two 1.5-ton), together with a 10-ton fixed hand crane. There is a small dry dock in the port, 65 m. (213.2 ft.) long. The trade of Granville is equally balanced between imports and exports, and the coastwise traffic is considerable.

Many small ports are situated along the northern coast of Brittany. At the head of the large Baie de St Brieuc, is *Le Légué*, the port for St Brieuc. There are two wet docks entered by a lock which limits the size of vessels using the port to 87 m. (285 ft.). Vessels drawing 3 m. (10 ft.) can enter the port at M.H.W.N., and vessels drawing 5.2 m. (17 ft.) at M.H.W.S. The two basins provide twenty-one berths, although at the end of one basin the depth is lower than in the rest of the harbour. There are two small cranes.

Westwards from St Brieuc lie many other little harbours. Three take some part in foreign trade, *Paimpol* (pop. 2,400) *Tréguier* (pop. 2,600) and *Lannion* (pop. 5,700), but they are very small and are used more by fishing boats and coasters. *Morlaix* (pop. 10,600) is more considerable. It lies some distance from the sea, on the Rivière de Morlaix; the channel is difficult for vessels over a length of 50 m. (165 ft.), and the maximum length for the port is 65 m. (213 ft.). The port consists of an avant-port and a wet dock; in the avant-port the berths dry 3 m. (10 ft.); in the wet dock depths of 5.5 m. (18 ft.) are usually maintained along the western quays. Altogether there are six berths for vessels drawing less than 6 m. (19.7 ft.). At the western side of the Baie de Morlaix, nearer the open sea, stands the small port of *Roscoff*, which carries on an active export trade in vegetables. Its harbour consists of two open basins protected by jetties in which the berths dry. There is a marine biological laboratory here. (For a map of this port, see Fig. 89, vol. I.)

There are three other harbours on the northern coast of Brittany which are classified as ports in the French Navigation Returns: *La Houle*, near Cancale, several km. east of St Malo; *Primel-Trégastel*, to the north-east of Morlaix; and *L'Aber-Wrach*, on the large estuary near the western extremity of this coast. The first two handle insignificant quantities of cargo, but L'Aber-Wrach, though of no importance for foreign trade, handled 24,000 tons of coastwise cargo in 1937.

*For bibliographical note see pp. 220-222.*



## Chapter II

### ATLANTIC PORTS

Brest: Lorient: St Nazaire: Nantes: Subsidiary Ports of the Loire: La Rochelle and La Pallice: Rochefort: Tonnay-Charente: Bordeaux and the Gironde Ports: Bayonne: Minor Ports of the Atlantic coast

#### BREST

(See Figs. 21, 22; Plates 20, 21)

##### *General Description*

This great naval base is magnificently situated on the almost land-locked Rade de Brest. The town, which has a population of 79,000, lies at the mouth of the Penfeld river on the northern side of the Rade.

A line joining the rocky headlands of Pointe de St Mathieu and Pointe de Pen-tir marks the seaward end of the great inlet formed by the combined mouths of the Elorn and Aulne rivers. This inlet is almost cut into two by the northward-projecting peninsula of Quélern, which divides the Avant Goulet on the west, a broad channel with the wide Baie de Bertheaume on its northern side and the narrower Camaret bay on its southern side, from the Rade de Brest, an inner haven or 'sound', on the east. The narrow channel between this peninsula and the northern mainland is known as the Goulet de Brest. Its rocky sides bristle with fortifications, and its existence is the main reason for the almost impregnable character of the naval base. The Goulet is just over 5 km. long and at its narrowest is only 1.8 km. wide. The navigable channel is further restricted and divided into two passages by a medial bank 2.7 km. long with depths of under 18 m. (59 ft.) and several rocky patches such as Les Filettes and Roche Mengant. The constrictive effect of the Goulet on the tidal streams results in increased velocity, and in the passages both north and south of the bank the stream reaches  $4\frac{1}{2}$  knots; strong westerly winds are apt to create very rough water in the northern passage when the stream is flowing out against the direction of the wind.

East of the Goulet the channel opens suddenly into the great Rade de Brest, a water area of some 15,000 ha., large enough and deep enough to accommodate all the fleets of Europe. Into this Rade the Landerneau river (or Elorn) flows from the north-east, and the

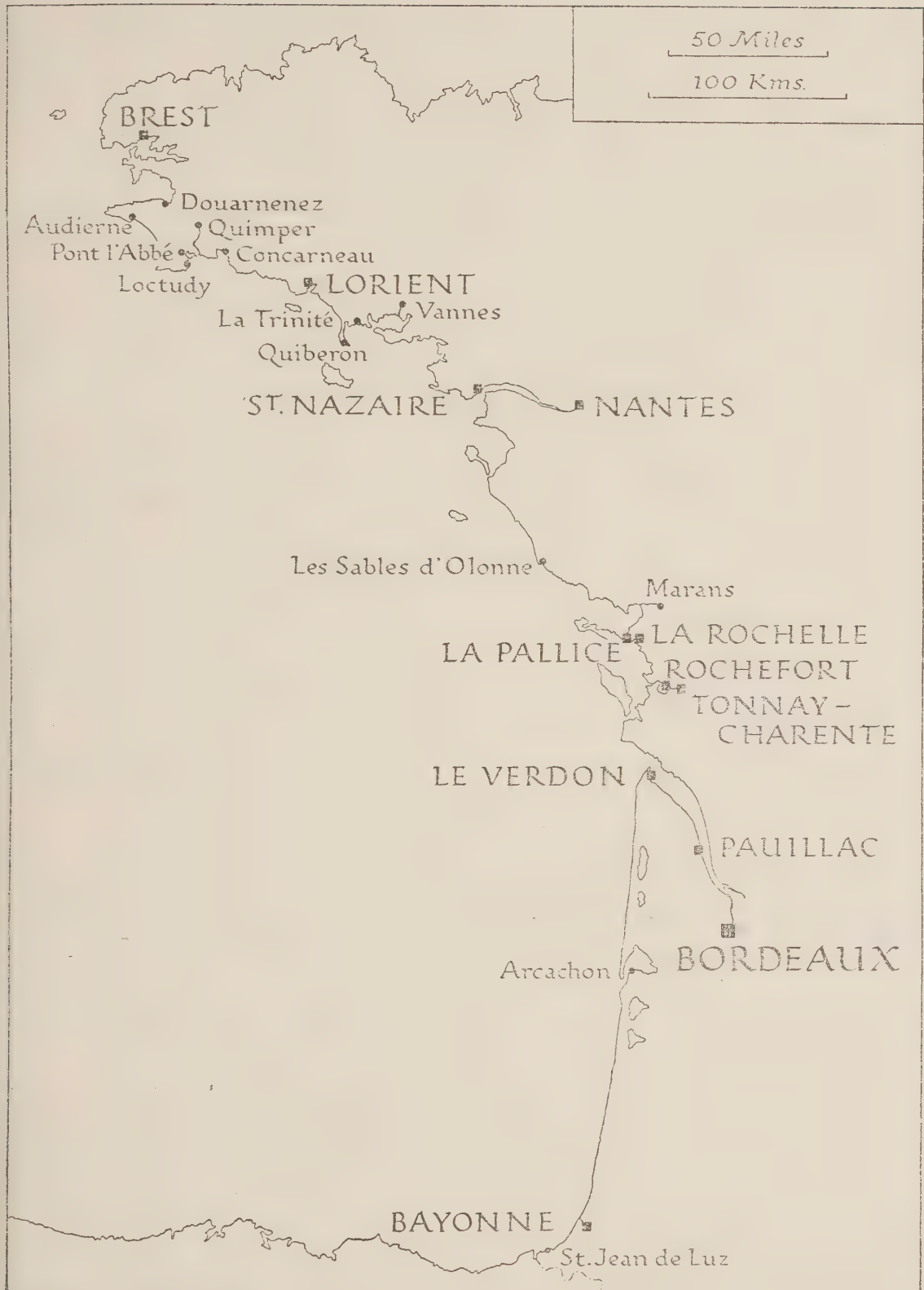


Fig. 20. The Atlantic ports of France

The very small ports are not shown (see p. 160). For the subsidiary ports at the Lower Loire and the Gironde, see Figs. 27, 35.



Châteaulin river (or Aulne) from the south-east. In the final approach to Brest harbour the St Pierre bank, south of the port, has only 9.6 m. (31.5 ft.) of water over it; whilst to the south-east is the St Marc bank, with only 5.5 m. (18 ft.). The latter severely restricts the use that can be made of the eastern entry into the commercial port. The entrance passage between the two principal breakwaters, the Jetée Sud and the Jetée Est, is under 300 m. wide, but has depths of between 8.2 m. (27 ft.) and 18.3 m. (60 ft.). It leads into the Rade

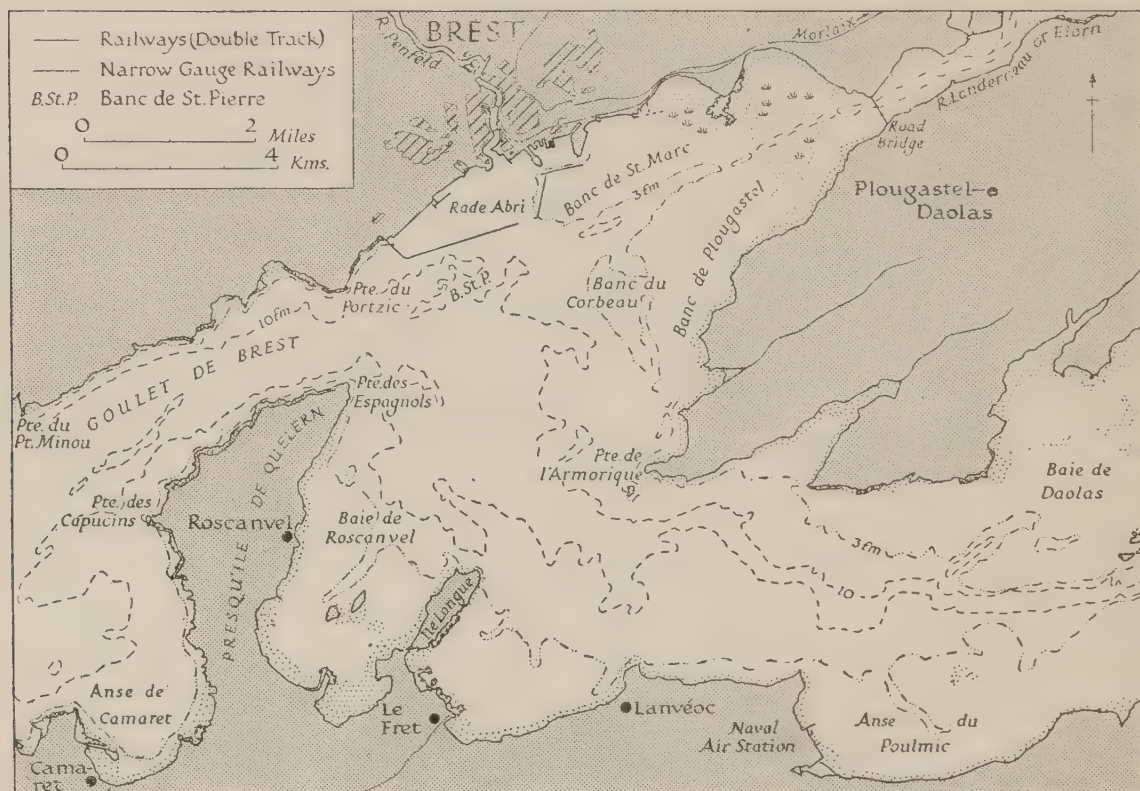


Fig. 21. Rade de Brest

Eastwards, beyond the margin of the map, the roadstead rapidly narrows to the estuary of the Châteaulin river.

Abri or protected roadstead, most of which, apart from the eastern end which leads to the commercial port, is reserved for naval vessels and seaplanes.

The port is tidal throughout, and there are no locks. The largest capital ships can use the Lannion section of the naval port, and twelve ships can also be berthed in the channel of the Penfeld river. The commercial port is accessible at all tides and has nearly 1,800 m. of quays of which 1,400 are accessible at M.H.W.S. to vessels drawing more than 6.5 m. (21.3 ft.) and provides fifteen berths. The length of vessels which can use the port is limited only by the difficulty of

manœuvring, since ships more than 150 m. (500 ft.) long are liable to be awkward to turn if a fresh westerly wind is blowing.

### *Detailed Description*

The port of Brest consists of the commercial port and two private basins, together with the naval base, comprising the 'port militaire' in the Penfeld river, bordered by the various workshops of the arsenal, the quays of Lanninon, west of the river mouth, and the Rade Abri. The Rade Abri is sheltered by three breakwaters: the Jetée Ouest, 600 m. long, the Jetée Sud, 2,200 m. long, and the Jetée Est, 900 m. The last of these is joined at its northern end to the Digue du Sud or south breakwater, 760 m. long, which protects the commercial port. This breakwater leaves a passage 140 m. (459 ft.) wide between it and the west mole, and a slightly narrower passage 122 m. (400 ft.) wide between it and the east mole. The former passage (Passe de l'Ouest), by which the commercial port is entered from the Rade Abri, is the more important of the two, having depths of 4.9 m. (16 ft.) to 5.5 m. (18 ft.); the eastern passage (Passe de l'Est) is shallower, only 1.5 m. (5 ft.), and can only be used by small vessels, which also have to cross the Banc de St Marc in order to reach the open water of the Rade de Brest. The *minimum* depth in the approach to the commercial port is 7.5 m. (24.5 ft.).

The commercial port has a water area of 41 ha.; it is bounded by two large moles and is divided by short moles (or 'spurs') into five basins which are open to the south. The quays are along these basins, and have a total length of 1,720 m. Most of the traffic is dealt with at the wharves on the inner sides of the west and east moles which deal with general trade, and in Basin no. 2 which handles grain, nitrates and general trade. The northern quay of Basin no. 5 (also known as Grand Bassin du Nord-Est) is the only specialized quay, being largely devoted to coal traffic, phosphates and pyrites. Basin no. 1 dries at its inner end, Basin no. 3 would appear not to be used at all, and Basin no. 4 contains two repairing grids. The warehouses on the moles and spurs have a total area of about 20,000 sq.m. If to this figure are added the landing stages and uncovered stocking places of the port, a total surface of about 95,000 sq. m. is obtained. The weight of merchandise that can be accommodated is about 150,000 tons.

East of the commercial port are the two private basins of Poullic-al-lor, serving the gas works and oil refinery, and Port Tritschler serving a chemical works.



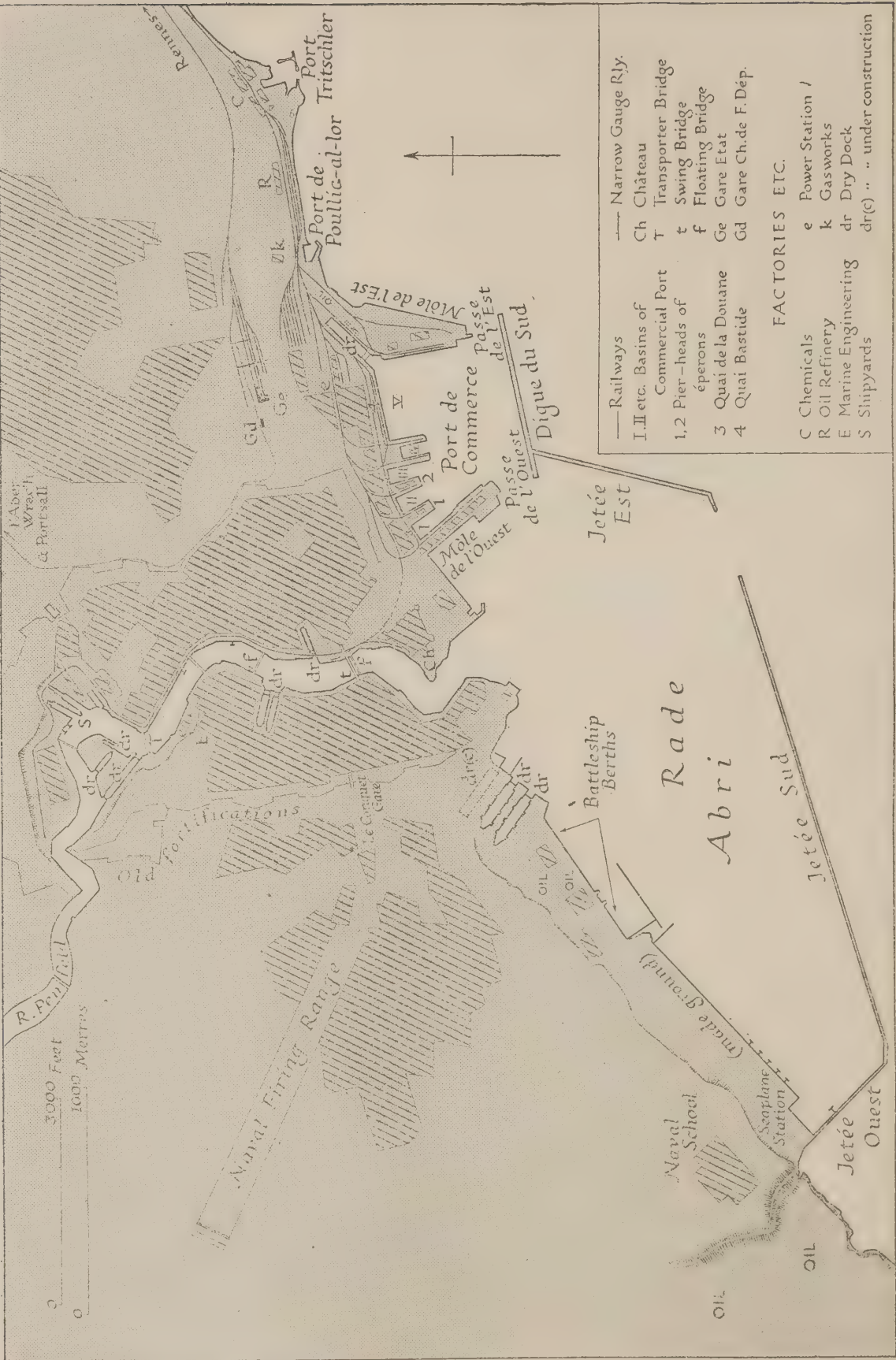


Fig. 22. Brest

The accommodation in the commercial port may be summarized as follows:

Section of port	No. of berths	Draught		Length m.
		m.	ft.	
*Bassin No. 1 incl. end of éperon (spur) No. 1	1	5.0	16.5	75
	1	6.0	19.7	50
	2	7.0	23.0	340
Bassin No. 2 incl. end of éperon (spur) No. 2	1	5.5	18.0	85
	1	6.0	19.7	50
	2	7.0	23.0	260
Grand Bassin du Nord-Est	5	7.0	23.0	545
Appontement Est	1	7.0	23.0	165
	1	10.5	34.5	150
	15			1720

\* Northern part dries at low water. The draughts given for the berths are those which are possible at exceptionally low water, when the height of the tide is only 0.5 m. above the datum of the French charts, i.e. the lowest observed tide level.

The *port militaire* occupies the Penfeld river for about 2.7 km. from its mouth; a depth of 10–12 m. (32.8–39.3 ft.) is to be found there at the lowest tides. The valley is deep and narrow, with a narrow terrace on each side bounded by a steep bank. On these terraces lie a number of long and narrow factory buildings, e.g. the rope works, 400 m. long, other parts of the arsenal, including the engineering shops, being located upon the plateau, 25 m. above the river level. The river is crossed by four floating bridges, a lifting bridge, a transporter bridge, and a high-level turning bridge 117 m. long and 21.7 m. above the river; the last named can be opened by four men in 15 min. (see Plate 20).

At the Lanninon quays the depth alongside has been increased sufficiently by dredging to allow the largest capital ships to berth. Thus it was here, and in the neighbouring dry docks, that the *Scharnhorst* and *Gneisenau* lay for so long in 1941. There is some oil storage behind the Lanninon quay, but the main oil stock is underground, just west of the root of the west jetty.

### Port Facilities

The commercial port is equipped with thirty-nine cranes, including eight 5-ton machines. At the root of the east mole is a dry dock, which has a bottom length of 222.5 m. (730.5 ft.), width at entrance 26.7 m. (87.8 ft.), depth on sill at M.H.W.S. of 12 m. (39.4 ft.).



In no. 4 Basin there are two careening grids, 110 m. (361 ft.) and 32 m. (105 ft.) in length; the former can take vessels of 1,200 tons. The *port militaire* has several very large cranes which are used in the fitting out and arming of warships; the largest can lift 150 tons (see Plate 21). It contains nine dry docks, the largest of which are the two at Lanninon, each 250 m. (820 ft.) in length, 36 m. (118 ft.) wide at the entrance and capable of accommodating battleships; the others are situated in the *port militaire* up the Penfeld river, including a large one cut across the neck of the Salou meander.

### *History*

Both naval and commercial ports grew originally within the confines of the deep and winding mouth of the Penfeld river, and both have since expanded beyond it, the commercial port to the east and the naval port to the west. The town has few features of interest, but the Castle Hill and Cours d'Ajot promenade along the old ramparts provide fine views across the Rade.

Although Brest is to-day the principal naval base in northern France, it came into prominence far later than the Channel ports, for naval warfare did not become oceanic until many years after it had been intensively conducted off the shores of the Narrow Seas, where great trading cities faced each other across the water and invading armies passed to and fro. Brest was a Roman fortress, but it lapsed into insignificance until the building of its thirteenth-century castle. The English King Edward III maintained a garrison there for over 50 years during the fourteenth century. During the sixteenth century several attempts were made by both English and Spanish forces to gain control of Brest and to destroy the French fleet based thereon. Thus in 1511 an English fleet under Sir Edward Howard ravaged the Brittany coast and later unsuccessfully attempted to destroy the French fleet in Bertheaume bay. In 1594 Spanish forces advanced from the south-east and erected a fort at Le Crozon, on the south side of the Rade, and an English army of 4,000 men with a fleet of ships under Frobisher was sent to expel the enemy, which it succeeded in doing.

The rise of France as a naval power under Richelieu and Colbert in the seventeenth century was accompanied by the growth of Brest as a naval base and arsenal. Richelieu began the naval base in 1631; Vauban built the first dry dock in 1687, on the site of the present Tourville dock, and considerably increased the fortifications in 1693. Brest superseded Rochefort and became the main base for the French

fleet in the west. An Anglo-Dutch expedition sent to destroy both base and fleet in 1694 was repelled with heavy loss in Camaret bay. Throughout the French wars of the eighteenth century English sea strategy pivoted on Brest. The 'Western Squadron' made its first appearance in Queen Anne's war, and it was by means of the blockade that the various designs of the French were frustrated. Nevertheless, during the eighteenth century Brest continued to develop its defences.

Until the middle of the nineteenth century naval and commercial shipping had shared the mouth of the Penfeld river, but the expansion of the arsenal and the cramped situation of the narrow and winding river rendered the construction of a new commercial port essential. The new port was built at the mouth of the Porstrein creek, east of the Penfeld, between 1865 and 1876. Towards the end of the century the necessity for increased shelter for large naval vessels led to the formation of the Rade Abri by the building of the long south breakwater, with the two shorter breakwaters. The former 'plage' of Lanninon became a vast expanse destined for future dock and arsenal construction. Two large dry docks and a submarine base were built in the eastern part of this area during and after the war of 1914-18. Although the Lanninon shore was by no means fully occupied, the naval authorities in 1925 began the reclamation of another area on the eastern side of the Penfeld mouth, immediately below Castle Hill, but in 1937, after this work had been completed, a return was made to the former area, and a new quay was built along the western part of the shore of the Rade Abri, the area behind being filled in and prepared for a new naval seaplane station and other works. The quay was completed in 1939 and the filling in has since been accomplished, together with the construction of the seaplane base and a number of submarine berths along the quay. In 1941 also a new dry dock, larger than the other two, was in course of construction; as a result of these works the hamlet of Lanninon has ceased to exist.

Although traffic had quintupled since the building of the commercial port, there were few alterations or additions there until the construction of concrete wharves along the east mole during 1928-36. Another recent work is the widening of this mole by the construction of a new sea wall on its eastern side. There has also been an improvement of the facilities for oil traffic east of the main commercial port, where the small basin of Poullic-al-lor has a pipe-line to the new oil refineries as well as serving the gas works. Proposals for future development included the transfer of the careening facilities to a position east of the commercial port.



*Trade**Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	403·9
Exports	211·9
Total	615·8
Coastwise trade (total)	342·9
Total sea-borne trade	968·7
Total foreign trade 1938 (provisional figures)	907·4

The foreign trade of Brest is less ill-balanced than in many French ports, for exports amount to half the weight of imports. The coastal trade is fairly important. There has been a great increase in the number of large vessels trading with French North Africa, etc. There are regular lines to other French ports and to Algeria. The shipping arrivals include those at the various creeks such as Plougastel, where in 1929, for example, fifty-seven British boats arrived to carry the strawberry harvest.

Pig iron and coal from Britain, timber and ice from the Baltic and Scandinavia, pyrites from Spain and superphosphates from Belgium, are the chief direct imports from abroad. Dunkirk and Havre send petroleum, cotton, coffee and nitrates; and coastwise also come home-produced foodstuffs such as sugar, grain and wine. These goods are consumed locally and feed industries in the immediate hinterland. Shipbuilding yards and the arsenal absorb most of the heavy goods and flour mills the grain. Pit-props, fruit, vegetables and fish are exported abroad. The import of Algerian wine has grown considerably in the past twenty years.

The hinterland of Brest is limited in extent and not productive of many commodities which enter into trade, while there are competitors for such trade as there is. Brest lies at the end of a direct railway route connecting the most densely peopled part of Europe with the Atlantic Ocean, and has the largest sheltered harbour in the whole continent, yet it has failed to develop as a great commercial port, owing to the poverty of its hinterland, to frequent storms, and to high fog incidence on the rocky coast, which results in high insurance premiums.

*Industries*

The outstanding industry of Brest, is, of course, the business of the naval port and arsenal. All types of naval construction and repair are undertaken. There are two covered slips on the northern bank of the Salou meander, 2 km. up the Penfeld river; during the war

of 1914-18 thirty-two ships were launched here in  $3\frac{1}{2}$  years, and the yard has since built several large cruisers, including the 10,000-ton *Foch* and the stern portions of the battleships *Richelieu* and *Dunkerque* (the bows of which were attached at Lanninon). Close by is a slip where two submarines can be built side by side. The great factories which supply the materials for shipbuilding line the banks of the Penfeld on both sides. Constructional iron and steel work is fabricated in a large shop built on land created by the excavation of Bougen cliff, on the left bank of the Salou meander; the foundries and engine shops lie on the Capucin plateau, on the right bank just south of the meander. South of the Pontaniou dry docks on the right bank are the artillery shops. The left bank below the Salou meander is lined with rope and cordage mills.

The industries served by the commercial port include the flour mills behind no. 5 Basin, the oil refinery east of the Poullic-al-lor basin, and large chemical factories, using Tunisian phosphates, behind Port Tritschler. A large explosives factory is located at St Nicolas, 9 km. east of Brest up the Elorn river.

### *Communications*

The sheltered waters of the roadstead and of the two river mouths which enter it permit a number of services by local passenger and cargo steamers. Regular services are run to Le Fret, Lanvéoc, Quélern, and Châteaulin: seasonal or irregular sea communication is also maintained with Plougastel, Douarnenez, Ile de Sein and l'Aber-Wrach. A regular service to the island of Ouessant (Ushant) runs from Le Conquet, connected to Brest by a road service which has replaced the former tramway. Some 180,000 passengers and 50,000 tons of goods cross the Rade annually on these ferry services.

The only *route nationale* reaching Brest is R.N. 12 from Paris, which runs eastwards to Landerneau, keeping to the plateau level and avoiding the bank of the Elorn river. Several *grande communication* roads radiate from Brest, to Le Conquet, Ploudalmézeau and Lesneven; these likewise avoid the deep-cut valleys.

The commercial port and the lower end of the *port militaire* are connected by standard-gauge railway tracks to the main line which runs eastwards to Paris via Rennes. The light railways run by the Ch. de F. du Finistère have lost much of their importance since the advent of motor-omnibus services, and all that remains is a meagre service of steam trains, supplemented by rail cars and motor buses, to Lesneven, branching thence to Roscoff, Brignogan and Landerneau.



## LORIENT

(See Fig. 23; Plates 22, 23)

*General Description*

Although chiefly known as a naval base, Lorient (pop. 46,000) merits distinction also as being in the first rank of French fishing ports. Its commercial importance is only secondary. The combined port of Lorient-Kéroman lies at the head of the ria formed by the union of the Blavet and Scorff rivers, about 6 km. from the open sea. Lorient itself is situated on the right bank of the Scorff immediately above its confluence with the Blavet. The modern fishing port of Kéroman lies on a promontory jutting out into the Blavet river between La Perrière bay and the mouth of the Ter river.

The approach to the mouth of the ria, which is somewhat sheltered from south-westerly winds by the Ile de Groix, is made between the rocky granitic headlands of Talut Point and Gavre Point. A triangular rocky bank lying between 1 and 2 km. west of Gavre Point divides the entrance into Lorient Harbour into two channels, the 'West Pass', or 'Chenal', lying between the bank and the Saisies reef, which separates Kerguelen and Larmor bays, and the 'South Pass' between the bank and Gavre Point. The two passes meet at about  $1\frac{1}{2}$  km. north-west of Gavre Point, and the main channel then leads in a direction slightly east of north towards Lorient. The shores of the inlet are indented with a number of small bays, mostly occupied by drying mudflats. Between Port Louis Citadel and Kernevel fort, the width is reduced to 550 m. and the navigable channel is only 119 m. wide, but immediately to the north, just south of St Michel island, the river widens to more than 3 km. St Michel island (which is a quarantine station) divides the channel into two; the western passage is the more important, for it is not only wider (though reduced to 100 m. in places) but also leads directly to the port of Kéroman. The channel widens again at the junction of the Scorff and Blavet rivers, where excessive deposition of silt has made dredging more necessary than elsewhere; but the final approach to Lorient up the mouth of the Scorff is again very narrow.

The set and strength of the tidal streams in the river are complicated by the division of the channel and its variable width, and by the amount of fresh water coming down the rivers. The flood stream does not exceed 2 knots except in the narrows between Port Louis and Kernevel, where it reaches  $3\frac{1}{2}$  knots; the rate of the ebb is  $2\frac{1}{2}$  knots, but in the same narrows it may attain 4 knots, especially

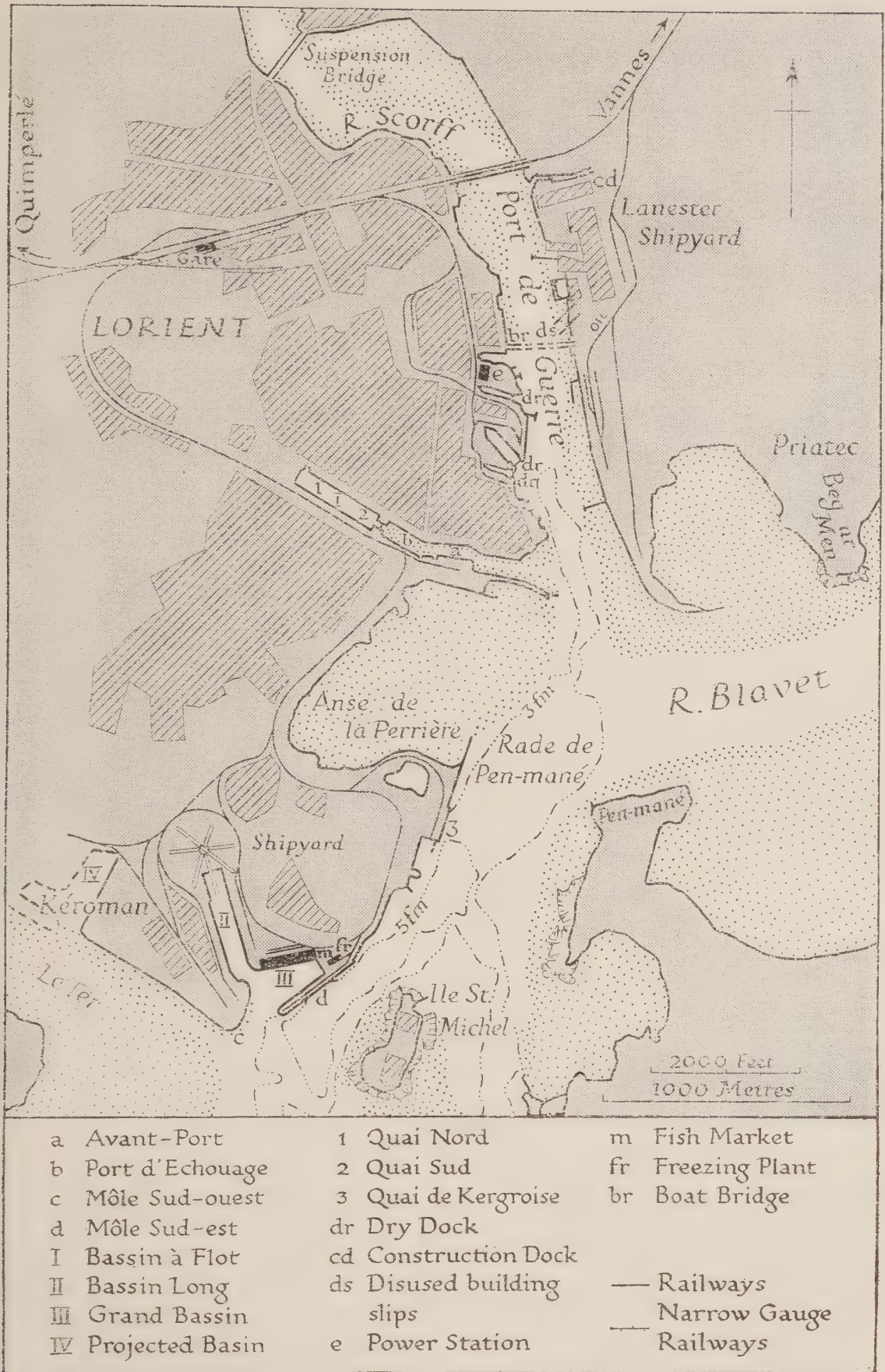


Fig. 23. Lorient



when there is much fresh water coming down. A curious phenomenon occurs in these narrows in winter after heavy rain, when the stream sets constantly outwards, the flood stream running in below the outgoing surface water; large vessels may experience difficulties at such times.

Apart from the naval port, the commercial section of Lorient-Kéroman, with 2,700 m. of quays, can accommodate about twenty small merchant ships and colliers and some sixty-five trawlers. There are, however, only two berths for vessels as large as 6,000 tons.

Detailed Description

The port of Lorient comprises (i) the naval base, occupying both sides of the river Scorff below the railway bridge, with building slips on the left bank and dry docks on the right bank; (ii) the commercial port on the southern side of the old fortified town, consisting of an entrance channel, an outer harbour and stranding basin, and a wet dock, and the more modern Kergroise quay, on the north-eastern side of the Kéroman-La Perrière peninsula; (iii) the fishing port of Kéroman, with two basins. Access to the commercial port can be obtained on a draught of 3·4 m. (11 ft.) at H.W.L.N., 4·0 m. (13 ft.) at M.H.W.N., and 5·0 m. (16·5 ft.) at M.H.W.S. In the fishing port the maximum depth is 5·8 m. (19 ft.) at M.H.W.S., and 4·8 m. (15·7 ft.) at M.H.W.N. The following table summarizes the dimensions and facilities of the various basins and quays.

	Length of quay m.	Depths				Maximum draught		Berths
		M.H.W.S.		H.W.L.N.		m.	ft.	
		m.	ft.	m.	ft.			
Commercial port:								
Avant-port: Appt. des Chalutiers	105	6·0	19·7	4·4	14·5	—	—	5, for steam trawlers
Port d'Echouage:		5·5	18·0	3·9	12·7	—	—	4
North side	160							
South side	185							
Bassin à Flot:								
Quai Nord	312	—	—	—	—	2·4-4·0	8·0-13	10, for sailing vessels
Quai Sud	340	—	—	—	—	3·4-5·0	11·0-16·5	5 (coaling berths)
(= Q. Rohan)								
Quai de Kergroise	112	11·0	36·0	9·5	31·2	—	—	1, for 5,000-6,000- ton cargo vessels
Kéroman fishing port:								
Grand Bassin	570	—	—	—	—	4·2	13·7	20, for steam trawlers
Outside quay of Môle	435	—	—	—	—	8·0	26·2	3 (coaling berths)
aux Charbons and continuing quay								1 for 6,000-ton cargo vessels
Bassin Long	400	—	—	—	—	3·2	10·5	35, for fishing vessels

*The Commercial Port.* This occupies the site of a narrow creek which formerly provided a natural moat on the southern side of the old town. The narrow entrance channel, nearly 300 m. in length, leads from the mouth of the Scorff to the Avant-port, on the southern side of which is the 'Appontement des Chalutiers', a quay for steam trawlers. The eastern extremity of the pier which bounds the entrance channel is used by the ferry steamers to Port Louis. Immediately beyond the avant-port is the Port d'Echouage, or stranding basin, 70 m. wide and 160-185 m. in length. At the western end of this basin a dock gate 16 m. (52.5 ft.) wide leads to the wet dock (Bassin à Flot), 345 m. long and 70 m. wide. The depth on the entrance sill is 5.2 m. (17 ft.) at M.H.W.S., 3.8 m. (12.5 ft.) at M.H.W.N.; the dock is used by vessels of 800-1,200 tons.

*Quai de Kergroise* has a frontage of 112 m. on the Blavet ria, and a width of 41 m.; it is connected to the north-eastern side of the Kéroman-La Perrière peninsula by a curved jetty which carries a standard-gauge railway track. This quay deals with cargo vessels of larger dimensions than can be accommodated in the main part of the commercial port and is mainly concerned with coal imports.

The fishing port of *Kéroman* has two tidal basins. Grand Bassin is 250 m. long and varies in width from 185 m. at the entrance to 70 m. at the eastern end. The eastern mole, which separates the basin from the Blavet ria, carries a standard-gauge railway track and a coal depot. The Bassin Long is 305 m. long and 80 m. wide. This is the real centre of the fishing industry, and behind the quays are fish warehouses, a cold store and an ice-making plant.

### *Port Facilities*

The entire port has but eighteen cranes, mostly small except for three 10-ton machines on the Kéroman coal quay. The warehouse and storage space is likewise small; some 300 tons of merchandise can be accommodated under cover, and an additional 4,400 tons on the open quaysides. There are three state-owned dry docks in the naval base at Lorient, on the right bank of the Scorff, and vessels can also be repaired in the wet dock of the commercial port. The larger of the dry docks has a bottom length of 192 m. (630 ft.), width at entrance 36 m. (118 ft.), and depth on sill at M.H.W.S. of 11.8 m. (38.8 ft.). Between nos. 2 and 3 dry docks, there is a large Titan crane on the Scorff frontage, of 150 tons capacity, used in fitting-out operations.



## History

The town of Lorient, which dates only from the seventeenth century, has few features of interest. The urban area now extends considerably beyond the old fortifications, northwards as far as the St Christophe suspension bridge across the Scorff, and southward to Kéroman.

As a naval base Lorient has lost some of its former greatness, for many of its establishments, including most of the arsenal, have been suppressed. It is still a construction and repair port, however, and acts as a supply and repair base for local defence craft; it has also some importance as a training centre. There is a school for boy artificers, and the only training establishment in France for 'fusiliers marins'.

Lorient began, like its predecessor Port Louis (at first known as Blavet), lower down the ria, as a small commercial port, established in 1628 by a group of Breton merchants who traded with India. Its importance was small, however, until in 1664 the new 'Compagnie des Indes' selected it as a trading base and established storehouses and shipbuilding yards, giving the port its name of L'Orient. Early in the eighteenth century it was strongly fortified, and the amalgamation of the *Cie des Indes* and the *Cie d'Occident* produced a maritime power which threatened British trade. Accordingly, in 1746 an English expedition under General Sinclair and Admiral Lestock was sent to capture it with the object of striking a blow at the French East India trade. The army landed without difficulty in Pouldu bay, 12 km. west of the Blavet, and prepared to besiege the town, but the General lacked the resolution to carry out his task and re-embarked just as the French were about to surrender. Nevertheless, the English cause triumphed in the east, and with the decline of French trade and the ruin of the *Cie des Indes*, the port passed into the control of the French government in 1770. Napoleon I improved and extended the accommodation, but Lorient did not figure as one of the principal naval bases during his wars.

During the nineteenth century there was a bold scheme for reclaiming 50,000 ha. of waste land in the hinterland, and this, together with the improvement of inland communications, gave a fillip to trade. Land deemed useless for agriculture was devoted to pine plantations, and the pit props so produced gave a satisfactory return cargo for the Welsh coal which was imported at Lorient and at the small smelting centre of Hennebont, 10 km. farther up the Blavet

river. The opening of the wet dock in 1863 gave an additional stimulus to the coal trade. In the late 'nineties two covered building slips were constructed, but the difficulties of launching large naval vessels in the narrow river Scorff led to the construction of a covered building dock of much larger dimensions than the slips. This dock, which was completed in 1921, enables ships to be built, as it were, in dry dock; when construction is completed the water can be let in and the ship floated gently out, thus avoiding all the difficulties of launching in a narrow river.

By a series of works carried out between 1919 and 1927 an entirely new fishing port was created at Kéroman, 2 km. south of Lorient, at the mouth of the Ter river where it enters the Blavet river; the natural contours of the land were considerably modified, and the new port became the largest specialized fishing port in France.

In 1939 plans were approved for new works which included the removal of rocks from the Pen-mané roadstead and from the Turc bank between St Michel island and Kernevel. Beg-ar-Men inlet was to be filled in and some 30 ha. of land reclaimed and utilized for building a fuel service station to complete the fuel-oil depot at Priatec. It was also intended to construct an aircraft factory at Pointe du Malheur. At the outbreak of war in 1939, only the first of these works—the dredging of the Rade de Pen-mané—had been undertaken.

Amongst other proposals which have been put forward for the improvement of the port are one for the construction of a large new basin on a site just west of Kéroman, at present occupied by mud-flats, and another for the south-western extension of Kergroise quay.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	359·4
Exports	68·7
Total	428·1
Coastwise trade (total)	106·5
Total sea-borne trade	534·6
Total foreign trade 1938 (provisional figures)	339·9

The principal import at Lorient is coal, mostly of British origin. This is destined mainly for local use, in the shipyards and for bunkers, or for the railways, but some small industries are also supplied, e.g. fish preserving at Kéroman and the small steelworks of



Hennebont. Some of the coal for the latter goes up the Blavet river. Other imports are phosphates, timber, Algerian wine, and petroleum, the last named being mainly for use in the naval base, which has a considerable storage capacity on the left bank of the Scorff. The main exports are pit-props and china clay. Some 70,000 tons per annum of pit-props form a useful return cargo for Welsh coal; much of this traffic comes down the Blavet from the Hennebont district.

The fish trade of the port has increased rapidly since the construction of the port of Kéroman. In 1913 Lorient dealt with 8,000 tons of fish; in 1926, 25,000 tons, and in 1936, 33,000 tons. The tonnage of fishing boats, at over 31,000, gave Lorient second place after Boulogne in the list of French fishing ports. Over 5,000 fishermen are employed. The catch comprises tunny and sardines from the Bay of Biscay, mackerel and herring from farther afield, and cod from distant deep-sea fisheries. In recent years Lorient has occupied second place to Boulogne in respect of weight of fish landed, and third place after Boulogne and La Rochelle if value be considered.

### *Industries*

The only industries of any importance at Lorient are concerned with the naval base and the fishing trade. The *Chantiers de Construction de Lanester*, situated on the left bank of the Scorff, just below the railway bridge, have three covered building berths, two disused slips, and considerable workshops. The two covered slips are 130 and 144 m. long respectively, whilst the large and more recently built covered dock is 250 m. long and 50 m. wide, covered by a metal roof. Noteworthy French naval vessels built in this dock are the cruisers *La Motte-Picquet* of 8,000 tons launched in 1924 and *Tourville* of 10,000 tons launched in 1926. The fitting out is usually done on the opposite side of the Scorff, at the quay on which the Titan crane is mounted. Another establishment for the repair of trawlers not exceeding 65 m. in length, or drawing more than 5 m., exists at the *Grand Bassin* of Kéroman. A series of five repairing berths radiate from a central turn-table on to which the vessels can be run from the slipway which leads down into the basin.

### *Communications*

*Waterways.* The Blavet river is navigable as far as Hennebont, 10 km. above Lorient. Vessels of 1,500 tons can go upstream as far as the railway bridge, about 1·2 km. below Hennebont, and most vessels of 800 tons can reach the town itself. Above Hennebont the



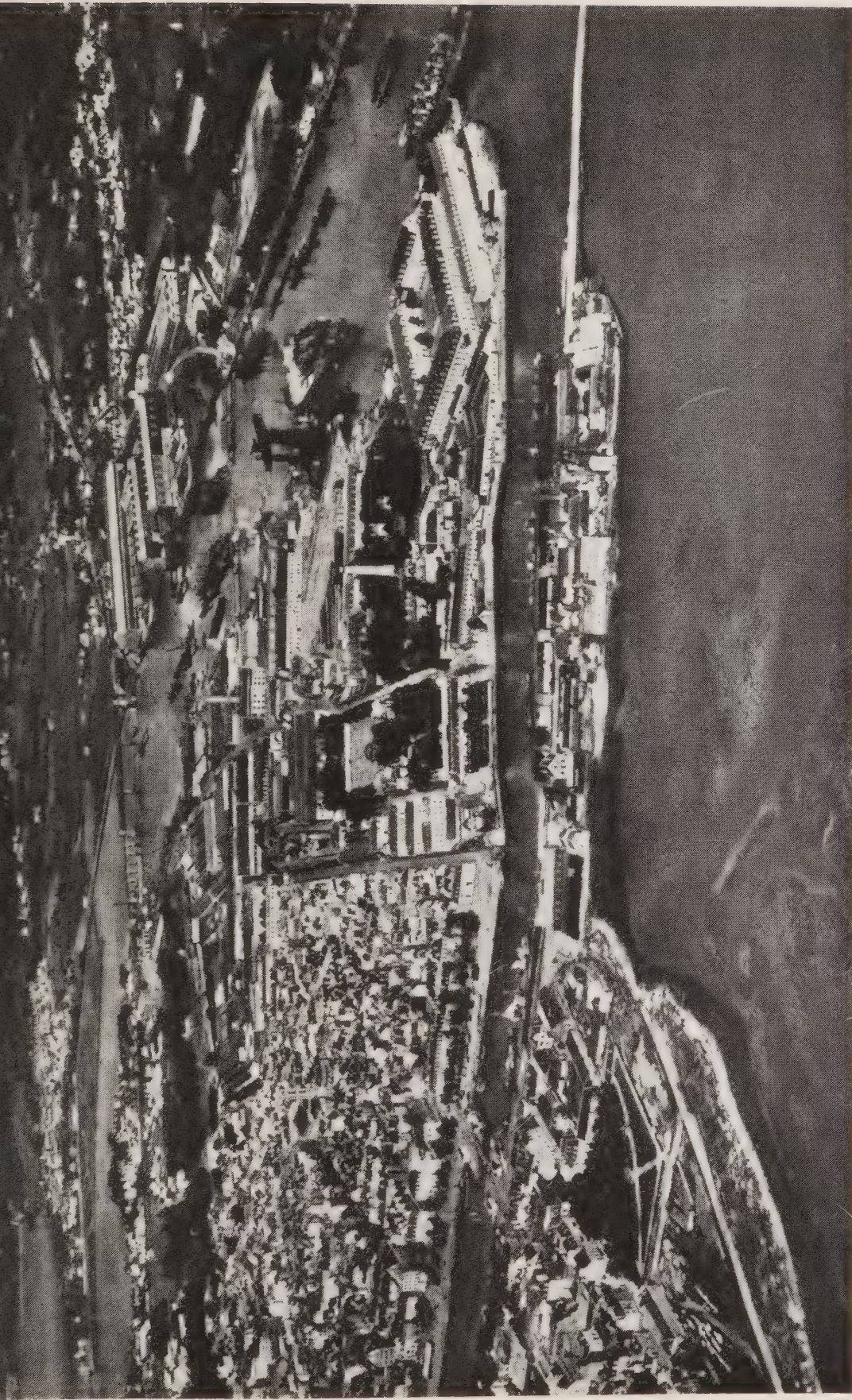


Plate 22. Lorient (looking north-east)

The Port de Guerre extends along the Scorff River from the right as far as the railway bridge in the background. Along the nearer bank are naval workshops, stores and barracks, while the 150-ton hammerhead crane stands out. On the farther bank are the submarine building slips and the extensive Lanester shipyard; the roofs of the covered construction dock and two covered building slips are clearly visible. In the foreground lies the long narrow commercial port, with the Bassin à Flot to the left and the Port d'Echouage to the right. (For map see p. 90.)





Plate 23. Lorient: the Kéroman coal quay

This quay, in the fishing port of Kéroman, is specially equipped with transporter cranes and hoppers for handling coal. (For map see p. 99.)



Plate 24. The mouth of the Loire (looking north-east)

St Nazaire lies in the centre of the picture on the north bank where the outer estuary narrows; the entrance jetties can be distinguished. The dredged channel from the open sea lies fairly close to the shore to the left of the extensive sandbanks, which show as light patches in the water. (For map see p. 123.)



river is canalized (see p. 442) as far as Pontivy, where it links with the Nantes-Brest canal.

*Roads.* Owing to their physical nature, the Scorff and the Blavet valleys are not followed by roads. The only main road exits from Lorient are *route nationale* 165 north-westward to Quimperlé and Quimper, and R.N. 24 (and 165) north-eastwards to Hennebont, where R.N. 24 continues east-north-east to Rennes, and R.N. 165 curves south-eastwards to Auray and Nantes. The immediate hinterland of Lorient, like much of southern Brittany, is but poorly served by roads.

*Railways.* The quays of Lorient, Kergroise and Kéroman, and the naval base on both sides of the Scorff, are linked with the south Brittany main line of the S.N.C.F. Western Region, which arrives from Nantes via Vannes and Hennebont, crossing the Scorff just above the naval base, and proceeds north-westwards via Quimperlé and so to Brest. There are no extensive marshalling yards at Lorient, the nearest being at Auray, 34 km. to the east, where the main line is crossed by the trans-Brittany line from Quiberon to St Brieuc. The local narrow-gauge Morbihan railway has a line running from Lorient (where the terminus is adjacent to the main-line station) inland via Plouay to Gourin, a distance of 75 km., but this line is of little importance. It links up at several places, e.g. Plouay and Gourin, with other parts of the 'intérêt locale' railway network of Brittany.

## ST NAZAIRE

(See Figs. 24, 25; Plates 24, 25, 26, 27)

### *General Description*

St Nazaire (pop. 43,000) stands on a rocky peninsula at the entrance to the Loire estuary. It is one of the newest of all French ports of any size, for in 1856 it was little more than a village. At first, as the approaches to Nantes became increasingly inadequate, deeper draught vessels lightened at Paimbœuf, a few kilometres upstream, but when this procedure became impracticable the site of St Nazaire was developed. St Nazaire is more than an outport of Nantes, for its trade has developed partly at the expense of the older port.

After negotiating the outer approaches to the mouth of the Loire, which are of considerable complexity, vessels pass through the Barre des Charpentiers, the bank extending across the entrance to the river, by the Charpentiers pass. This pass is a straight channel



200 m. wide with a depth of 5·8 m. (19 ft.), and is available in all weathers at high water to deep-draught vessels. From the northern end of the bar the buoyed channel continues with a width varying from less than 183 to 275 m. and with a depth varying from 6·4 m. (21 ft.) to 11·0 m. (36 ft.). The dredged channel is close to sand-banks, and so care is needed in entering. A heavy sea is never experienced in the Grande Rade, where anchorage may be obtained in depths from 11·0 to 14·6 m. (36–48 ft.), but it is preferable for large vessels to arrive at high water and to enter the basin without anchoring. The Petite Rade, which provides anchorage in depths of 5·9–11·0 m. (19·5–36 ft.), is often occupied by tugs and pilot boats; tidal streams are very strong in this roadstead. The waves entering the Loire estuary cross the Barre des Charpentiers, and expanding successively between the rocky points in the bay of Bonne Anse and Grand Traict, are greatly reduced in force by the time they reach the Petite Rade, so that the avant-port can safely be made smaller than usual. As St Nazaire is on the right or northern bank of the Loire, the strongest winds affecting navigation are from the south-west.

### *Detailed Description*

The port consists of two wet docks, Bassin de St Nazaire and Bassin de Penhoët, and an avant-port. The Bassin de St Nazaire is entered through the avant-port and the south lock, and the Bassin de Penhoët by the lock dry-dock from the estuary. Conditions of entry are as follows: depth in entrance channel, 10·0 m. (32 ft.) at M.H.W.S., 9·5 m. (31·2 ft.) at M.H.W.N.; maximum dimensions for entry by the south lock: beam 29 m. (95·1 ft.), length 210 m. (689 ft.); and by the lock dry-dock: beam 50 m. (164 ft.), length 350 m. (1,148·3 ft.). Entry to the avant-port and basins can be made on a draught of 9·5 m. (31·2 ft.) at M.H.W.S. and 8·5 m. (28 ft.) at M.H.W.N.

The avant-port opens directly from the Grande Rade and has an area of 8 ha. The two converging jetties are 124 m. (406 ft.) apart between the heads and 500 m. in length. A berth 210 m. long and 30 m. (98·5 ft.) wide, with depths of 8·0 m. (26·2 ft.) at M.H.W.S. and 7·0 m. (23 ft.) at M.H.W.N., has been dredged alongside the inner edge of the eastern jetty. This berth, the Quai de Marée, has 150 m. of quay, equipped with a railway (see Plate 25).

The Bassin de St Nazaire is 579 m. long, 160 m. wide and 10·5 ha. in area; on its western side is a recess 152 m. long and 90 m. wide, reserved for tugs and colliers of the *Cie Générale Transatlantique*. The average depth of the basin is 8·25 m. (27 ft.); in the north-east

corner it is only 7.2 m. (23.5 ft.). Silt accumulates in this basin at the rate of 1 cm. a day. The total length of quays is 1,738 m. at which thirteen vessels can berth simultaneously, eleven on a draught

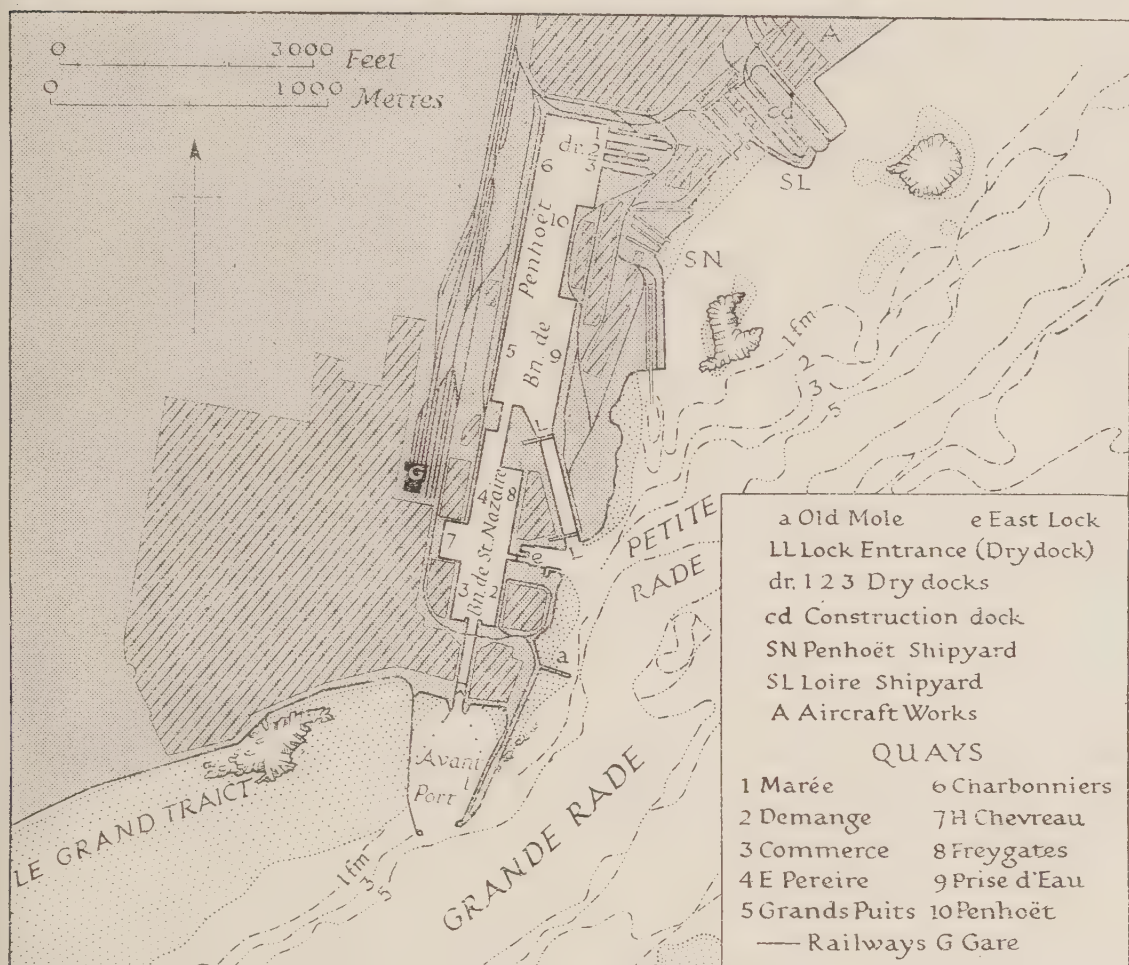


Fig. 24. St Nazaire

The Penhoët quay (10) is the fitting-out berth of the Penhoët shipyard; the quay at the extreme northern end of the Bassin de Penhoët is the fitting-out quay of the Loire shipyard (although this yard has also a fitting-out basin in the construction dock (see Fig. 25)). Since the German occupation the western recess of the Bassin de St Nazaire has been converted into a submarine shelter. In the raid by British forces in March 1942 the old East Lock (e) was torpedoed by a motor boat, in an attempt to make the Bassin difficult to use. The principal achievement in this operation was the wrecking of the outer or southernmost of the two sliding steel gates (LL) of the lock dry dock, leading to the Bassin de Penhoët, together with the pump house and lock machinery. The machinery of the inner gate was damaged, and the Germans have pumped sand into the outer dock to protect the inner entrance.

over 6 m. (19.7 ft.). The outer or south lock is the main entrance to the basin from the avant-port; it is 211 m. (692 ft.) long and 30 m. (98.4 ft.) wide and is crossed by swing bridges. This lock is divisible into two unequal parts 116.2 m. (381.4 ft.) and 77.0 m. (252.6 ft.)



long respectively; the depth on the sill is 10·2 m. (33·4 ft.) at M.H.W.S., and 9·0 m. (29·5 ft.) at M.H.W.N. The old east lock connects the basin with the river. The northern portion of this lock is now closed. The dimensions of the remaining entrance are: length 58·0 m. (190·3 ft.), width 13·0 m. (42·6 ft.), depth on sill at M.H.W.N. 6·0 m. (19·6 ft.). This entrance lies between two wooden pile jetties and is used only by river vessels and small craft as it is silted to 2·7 m. (9 ft.) with soft mud.

The Bassin de Penhoët lies directly north of the Bassin de St Nazaire and was originally connected with it by a lock which has now been replaced by a passage 34·4 m. (113 ft.) wide. The dock can be entered directly from the estuary by the new entrance lock (dry dock), which is 356 m. (1148 ft.) long, 50 m. (164 ft.) wide at the entrance, and has a depth on the sill at M.H.W.S. of 13·4 m. (44 ft.).

The basin, which is one of the largest wet-docks in Europe, is 1,000 m. long, 160–230 m. wide and its area is 22 ha. The 2,261 m. of quays, berthing twenty-eight vessels, are mainly founded upon rock save where they lie on the old bed of the river. The average depth is 8·0 m. (26·2 ft.), though the Quai de Penhoët provides a berth of 11·0 m. (36 ft.), 450 m. long and 50 m. wide. Nineteen berths have a depth greater than 6·0 m. (19·7 ft.). There is little accumulation of silt (see Plates 26, 27). On 2 November 1939 the depths in detail at the other quays were as follows:

Quay	Depths		Maximum draught of ships	
	m.	ft.	m.	ft.
Marée	—5·75	18·9	5·75	18·8
Demange	—3·15	10·3	8·15	26·75
Commerce	—3·30	10·8	8·30	27·25
Eugène Pereire	—3·30	10·8	8·30	27·25
Grands Puits	—3·00	10·0	8·00	26·25
Charbonniers	—3·80	12·5	8·80	28·9
Henri Chevreau	—	?	7·00	23·0
Frégates	—	?	6·00	19·75
Prise d'Eau: Sud	—5·00	16·5	10·00	32·75
Centre	—5·00	16·5	10·00	32·75
Nord	—4·50	14·75	9·50	31·1

Datum: Lowest level at low water of the lowest spring tides in France.

The new entrance lock is constructed of reinforced concrete with welded steel sliding gates. It was built when the *Chantiers de St Nazaire Penhoët* were building the *Normandie* during 1928–32, but is now used as a dry dock. The bottom of the lock is on bed-rock. The total length of the quays in the port is 4,800 m.

### *Port Facilities*

The two basins are equipped with thirty-five cranes, including one 180-ton, one 150-ton, and one 60-ton. There is little specialized loading and discharging gear. Warehouses are not particularly extensive, and there is little special storage accommodation.

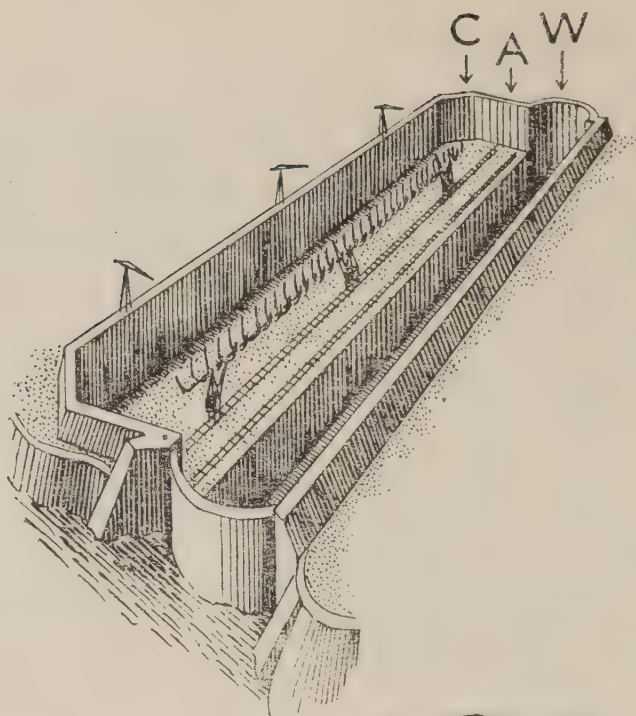
The shipbuilding industry, besides leading to the provision of large cranes, has stimulated the installation of four dry docks for repairs. A group of three dry docks, the longest of which has a length of 233·6 m. (766 ft.) and a width of 29·9 m. (98 ft.), is in the north-east corner of the Penhoët basin, and the fourth is the large new lock opening from the estuary into the south-east of this basin. These dry docks offer tariffs which are among the lowest in France and thus attract ships which are in need of repair.

### *History*

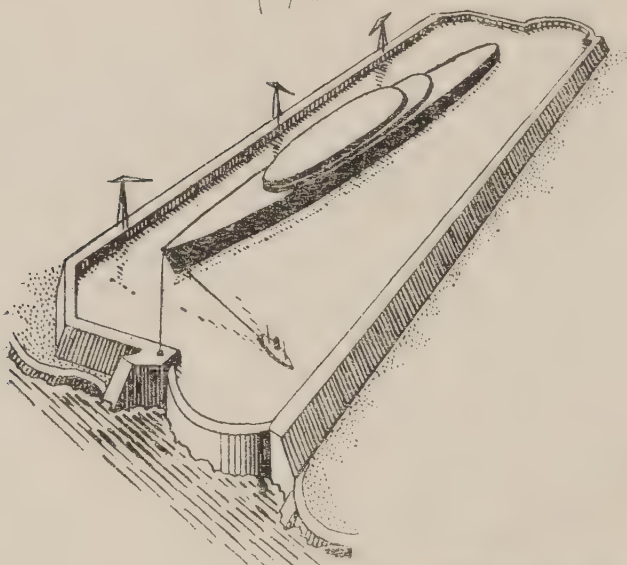
St Nazaire was a port in Gallo-Roman times, for antiquities have been recovered during the construction of the basins, but it remained insignificant for many centuries. Before 1800 there were only eighty families in the village, and although the first mole was completed in 1835, the population in 1856 was barely 3,000. The Bassin de St Nazaire was opened in 1856, and the town grew up almost overnight. Its progress reflected the inability of the older port of Nantes to deal adequately with channel problems of the Loire. The main industry of St Nazaire soon followed, for in 1861 the *Cie Générale Transatlantique* founded the Penhoët shipyards (later on they were organized as a separate company). The completion of the second basin, the Penhoët, followed in 1881. In 1907 the south lock and the avant-port, as it stands to-day, were constructed, and in 1913 the western quays of the Penhoët basin were completed. During the war of 1914-18 St Nazaire was a port of disembarkation for Canadian and American troops. In April 1942 St Nazaire was the scene of a daring raid by British combined forces, as a result of which the outer gate of the main lock entrance was wrecked and other damage inflicted (see p. 107).

The most recent dock developments were in connexion with the shipbuilding industry, and included the construction in 1933 of the large dry dock forming an entrance lock to the Penhoët basin. In 1938 the St Nazaire Chamber of Commerce prepared plans for a very large basin, enclosed by a river mole 600 m. long, above the shipyards, and which would be capable of holding the largest vessel afloat.

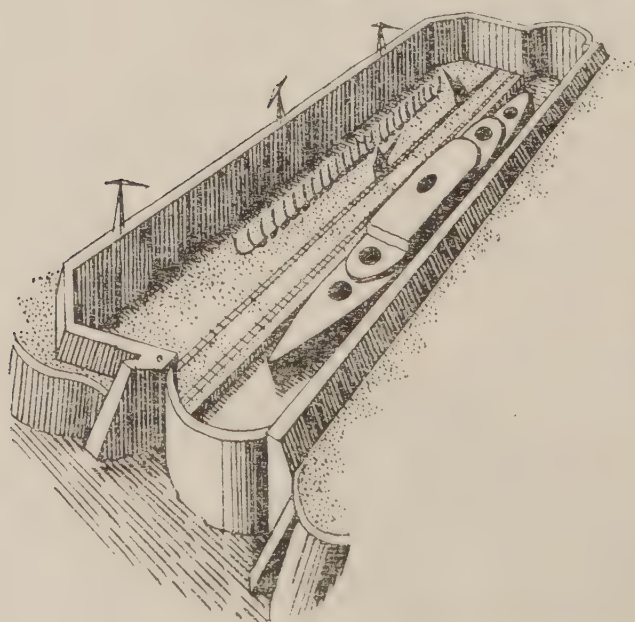




Construction of hull.  
Outside water level is  
shown at low tide.



Floating hull into wet  
dock. Outside water  
level is shown at high  
tide.



Fitting out hull, and  
new keel laid. Out-  
side water level is  
shown at low tide.

Fig. 25. (For description see p. 111)

## Trade

*Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	438.0
Exports	25.9
Total	463.9
Coastwise trade (total)	115.8
Total sea-borne trade	579.7

The trade of St Nazaire is extremely ill-balanced, and in 1937 consisted almost entirely of imports. Of the import tonnage, nearly 90 % consists of coal, mainly from Great Britain and Poland, with timber from Scandinavia, sugar, coffee and other foodstuffs from America, and wine from Algeria and Morocco making up the remainder. In some years, according to the state of trade in the heavy industries, there is an import of iron ore, largely from Spain. The exports con-

Fig. 25. The construction dock of the *Ateliers et Chantiers de la Loire* at St Nazaire (a diagrammatic representation)

C, construction zone; A, assembly zone (Zone de Montage); W, wet dock (fitting-out berth).

This dock was constructed during 1936-9 and was used for the building of the 35,000-ton battleship *Jean Bart*. It was designed to minimize delays arising from launching, vessels being built horizontally.

In order to avoid settlement over this large working area, foundations were taken down to half-tide level, which is ground-water level, as the subsoil is nearly impermeable. Spring tides oscillate from zero to +19.6 ft. (5.9 m.) and the construction-zone level was selected at +9.8 ft. (2.9 m.). Around the construction-zone, shop-walls 31.1 ft. (9.4 m.) high (top at +41 ft. (12.5 m.)) form a tank which can be filled by pumps to float the completed ship across to the fitting-out berth. The shop-walls are hollow so as to accommodate services such as compressed air, electricity and secondary workshops. The outside workshop floor level is +23 ft. (7.0 m.), similar to that of existing shops. The outside workshops open outwards for access and light; the inner side, from +9.8 to +41 ft., consists of a watertight wall pierced only for necessary passages, the doors being fitted with watertight bulkheads. The deep-water fitting-out berth is a wet dock of equal area, with its bottom level at -26.25 ft. (8.0 m.). This dock communicates with the river by means of a floating gate. Work can be carried out simultaneously on two large ships, one in the first stage of construction while the second, afloat in the deep-water berth, is being fitted out. Each berth can accommodate two or three ships of moderate size instead of one large ship. The length of each berth is 1,056 ft. (321.9 m.) and the width 147 ft. (44.1 m.). The stores area is 114 ft. (34.7 m.) by 1,056 ft. The floating gate is 147 ft. wide by 59 ft. (18 m.) high; at ordinary high tides the gate will pass ships drawing more than 32.75 ft. (10.2 m.). The new dock is situated between the existing steel works and the machine shops; hence transport is reduced to a minimum.

The 'assembly zone', at the same level as the construction dock, can be used for building small craft while the building of the main hull is in progress. This zone is straddled by a big crane which, during the floating operations, is countersunk into the end wall. The works railway enters at this end by a tunnel.



sist mainly of metals and minerals, in various forms, together with some quantities of pit-props and foodstuffs such as preserves.

Trade increased rapidly during the war of 1914-18, but afterwards declined, particularly after 1929, owing to the onset of the trade depression and to the reduction in the coal trade owing to tariff restrictions and the electrification of the Paris-Orléans railway.

### *Industries*

St Nazaire is one of the most important shipbuilding centres in France. Launching is very dependent upon winds and tides, and costly dredging is necessary before any large vessel can leave the slipways. For the passage of the liner *Normandie*, in 1934, which was constructed by the *Chantiers de St Nazaire Penhoët*, the channel from St Nazaire to the sea was deepened by 3.0 m. (10 ft.) by the dredger *Pierre Lefort*, which later opened the new pass at the entrance to the Gironde estuary. It was to avoid such difficulties that the *Chantiers de la Loire* constructed a special form of building dock. Designed for vessels 300 m. (984 ft.) long, it was completed in 1936 and was used for the building of the 35,000-ton battleship *Jean Bart*. This company now has only two slips, the remaining slips having been displaced by the construction dock. The yard has engineering and ordnance plants, including a turbine fitting shop, but the main engineering works of the company are at St Denis, Paris. The branch at Nantes constructs boilers for both yards, while the branch at St Nazaire deals with turbines for both. The *Chantiers de St Nazaire Penhoët* have five slips up to 335 m. in length, although two of these are not in good order. Boiler and plating shops adjoin the yards. There are two heavy engineering works in the port—a forge and foundry plant at Penhoët, and a large iron and steel works at Trignac, 2.5 km. to the north. The Trignac works, which include 175 coke ovens together with rolling mills and construction shops, manufacture plates and other heavy parts for the shipyards. A large aircraft factory, opened in 1927, lies adjoining the *Chantiers de la Loire* yards, with which it has financial connexion, while a nationalized aircraft factory manufactures seaplanes.

### *Communications*

There are about 40 km. of railway lines in the port serving all the quays. The main railway to Paris passes through Nantes, but there is a direct line via Châteaubriant and Le Mans; to the north and north-west there are direct connexions with Brittany. A good deal





Plate 25. St Nazaire: general view (looking north)  
 Departure of the *Normandie* following her completion. (For map see p. 107.)



Plate 26. St Nazaire: the Lock dry-dock entrance to the Bassin de Penhoët (looking north)  
 This view, which shows the *Normandie* docked, clearly illustrates the sliding gates of the dry dock; at the end of the gate recess is the building which houses the gate machinery, while the two-storey building near the dockside houses the pumping machinery. The workshops of the *Ateliers et Chantiers de St Nazaire Penhoët* shipyard appear behind the *Normandie*, while to the right, on the shore of the estuary, are the building slips; beyond these, upstream, is the *Ateliers et Chantiers de la Loire* shipyard. (For map see p. 107.)



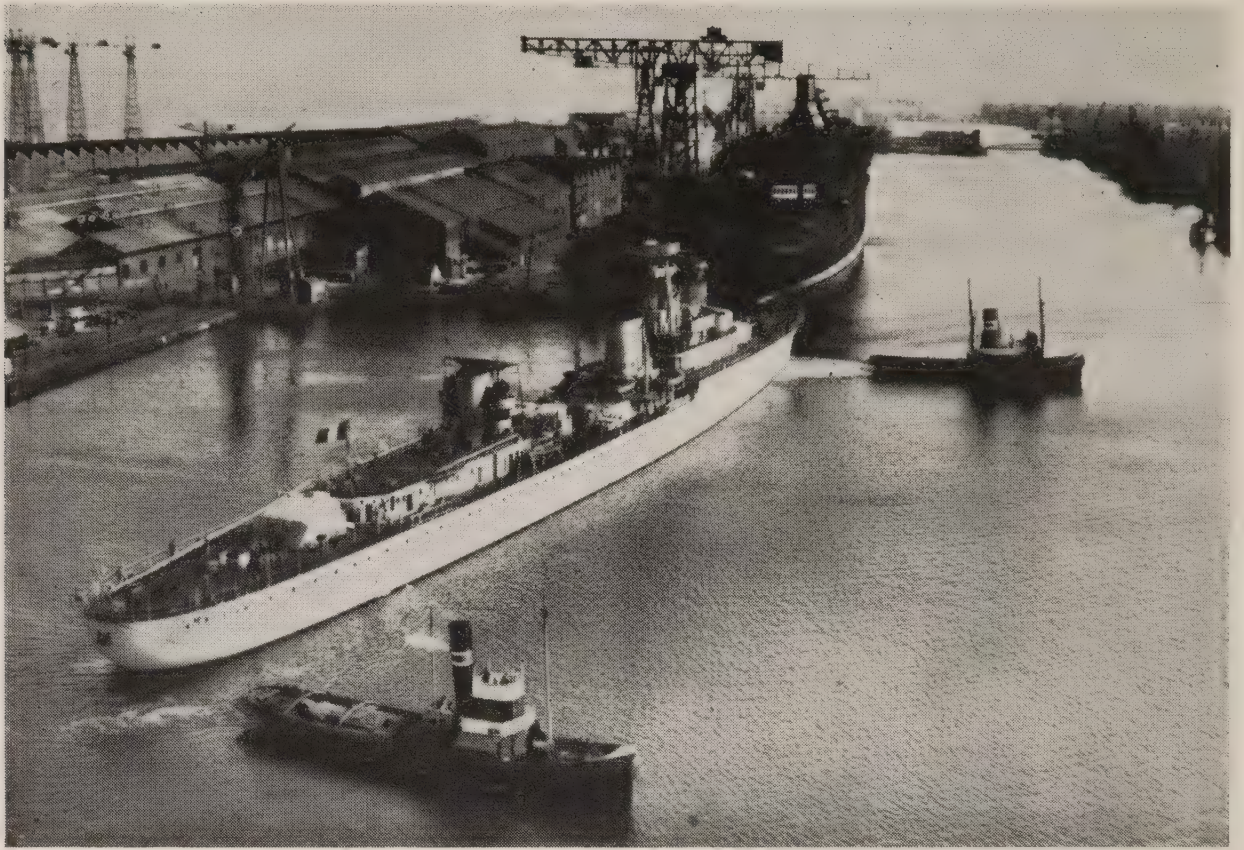


Plate 27. St Nazaire: Bassin de Penhoët (looking south)

On the left are the workshops of the *Ateliers et Chantiers de St Nazaire Penhoët* and the deep-water fitting-out berth with a large completed hull alongside. Beyond the bridged passage in the background can be seen the Bassin de St Nazaire. (For map see p. 107.)



Plate 28. Donges: petroleum discharging berth (looking upstream)

A coasting tanker is alongside. (For map see p. 123.)



of cargo is transhipped for conveyance to the ports higher up the Loire by a fleet of lighters of 300–600 tons. There are regular steamship services to Central America, the West Indies and Spanish Main, North Africa, Spain and Great Britain.

The future of St Nazaire is bound up with a variety of factors. Clearly, it depends to a considerable extent upon the ability of the Loire ports as a whole to maintain their trade and to attract trade from distant centres of population and industry. A second factor is the degree of success which attends the efforts of Nantes to improve the river channel and make itself less dependent upon St Nazaire. It is clear, however, that St Nazaire will always deal with the largest vessels, particularly if the size of ships continues to increase. A third factor is the future of shipbuilding, both mercantile and naval, in France. The shipbuilding companies and Chamber of Commerce of St Nazaire have sunk considerable capital sums in providing special equipment for building the largest vessels, and the yards will undoubtedly be able to deal with any orders which they may receive in the future.

## NANTES

(See Fig. 26; Plates 29, 30)

### *General Description*

Nantes (pop. 195,000) has always been the most important port on the Loire estuary, although in the past hundred years some of its trade has passed to St Nazaire. The city lies 50 km. from the sea at a point where the river is divided by several islands.

The position of Nantes may appear at first to resemble that of Rouen, but the river approach is much less satisfactory. For several centuries the Loire has created difficulties for navigation, while the prospect of increasing the depths in the channel is less certain than that existing for the Seine. The river is subject to torrential floods, its flow varying from 100 cu.m. a second to more than 6,000. There are 171 days when the depth is below the average, and, on the other hand, 100 days of flood.

### *Period during which Ships reached Nantes in 1938*

	Draught of ship		No. of days in the year
	m.	ft.	
Up to	6.45	21.16	365
	6.95	22.8	362
	7.75	25.4	255
	8.0	26.25	219



Below Nantes the Loire cuts through a belt of schists as far as Couéron, and there enters an alluvium-filled valley in which the current is unable to scour channels sufficiently deep for modern navigation. The waters of the estuary are always silt-laden, and this burden is partly deposited in the Bassin de St Nazaire, where it accumulates at the rate of 1 cm. a day. Each year five million cubic metres of silt have to be dredged from the river bed.

There are three sections of the Loire channel—the estuary proper which extends for 15 km. from the sea to Paimbœuf, the intermediate section from Paimbœuf to La Martinière (22 km.), and the dyked river for the remaining 19 km. to Nantes. The tidal stream and ebb run at rates from 2 to 4 knots below Nantes; at Nantes itself the stream is less perceptible when the river is high. At present vessels drawing less than 5·2 m. (17 ft.) can reach Nantes at all states of the tide, and those drawing 7·5 m. (24·5 ft.) at M.H.W.S. In 1938 the maximum draught permitted was 8·3 m. (27·25 ft.), or 7·5 m. (24·5 ft.) if the passage from Nantes to the sea was to be made in a single tide. Although depths have been improved by dredging and groyne construction, navigation is difficult and pilots are essential. A new dredger with a capacity of 750 cu.m. an hour was put into service in 1932. From 1933 to 1939 works were undertaken to provide a new channel which will be navigable continuously by ships drawing up to 7·25 m. (23·8 ft.).

### *Detailed Description*

Most of the principal quays of Nantes are on the right bank below the islands, and extend for 3 km.; they have depths of 8·5 m. (28 ft.) alongside. The longest of the quays, however, is on the south side of the island group. The maximum length permitted for ships berthing at Nantes is 170 m. (557 ft.). There are fifty berths, of which thirty-seven provide a depth over 6·0 m. (19·7 ft.). The dimensions of the quays at Nantes are as follows (see p. 116).

The Usine Brulée quay is equipped to deal with petroleum, tar, and nitrates; the Président Wilson and Roche Maurice quays handle coal imports, and the St Louis quay colonial fruit. The Usine à Gaz, St Louis, Fernand-Crouan and Ile Cheviré quays are of fairly recent concrete construction. The Fernand-Crouan quay needs frequent dredging owing to the rapid silting by soft sand which takes place. The André-Rhuys quay is used only by fishing and sailing craft.

There are three other quays. The total length of public quays normally used by sea-going ships is 5,300 m. Warehouse space is







considerable and adequate. Lighters are only used when goods are being sent to factories upstream. Several petroleum firms have established depots at the Usine Brulée quay, where the total tankage amounts to 48,000 cu.m.

Public quays	Length m.	Depth M.H.W.S.		Depth at low water lowest tides	
		m.	ft.	m.	ft.
Usine Brulée (or Emile Cormerais), three dis- charging berths, each 90 m. (295 ft.)	420	11·8	38·75	7·5	24·5
Usine à Gaz, one berth, 60 m. (197 ft.)	394	12·8	42·0	8·2	27
Roche Maurice	500	11·5	37·75	7·0	23
Cordon Bleu	175	8·7	28·5	6·4	14·5
lower end	45				
Private wharves	920	4·5	14·75	—	—
		6·5	21·25		
St Louis	396	10·8	35·5	6·5	21·25
d'Aiguillon	442	11·6	38	7·3	24
Ernest-Renaud	378	11·3	37	7·0	23
Président Wilson	1,553	11·8	38·75	7·5	24·5
de la Fosse	548	9·1	30	5·0	16·5
Antilles	556	9·8	32	5·5	18
Fernand-Crouan (or Prairie-au-Duc)	297	9·8	32	5·5	18
André-Rhuys	300	2·0-3·1	6·5-10·25	—	—
Ile Cheviré	1,607	—	—	—	—
Piperie	91	6·0-7·0 (M.L.W.S.)	19·7-23	—	—

(See Plate 29)

*Principal Private Quays: dimensions (where known)*

Quay	Length m.	Depth M.L.W.S.		
		m.	ft.	
Powell-Duffryn	—	6·5	23·5	Reinforced concrete
Blanzy-Ouest	177	3·5	11·5	
Société d'Importation de Charbons	—	8·0	26·25	
Tolvander	—	6·5	21·3	Ground-nuts, phosphates
Kuhlmann	90	7·5	24·5	
Chatel et Dollfuss	160	8·5	28	
St Gobain	199	6·0	19·7	Soap and oil refinery
Eymital	—	8·0	26·25	
Usine électrique	—	7·5	24·5	Oil discharge wharf
S.G.H.P. and Jupiter	—	—	—	

### *Port Facilities*

The port is equipped with ninety-eight cranes under 10 tons capacity and seven larger ones, including a 100-ton floating crane, besides a variety of specialized loading gear. There are eight sea-going tugs in the port, all owned by one company. There is a floating dock which, with a depth on the sill at M.H.W.S. of 6.1 m. (20 ft.), has a lifting capacity of 4,200 tons, and can accommodate ships 120 m. (394 ft.) long. The construction of a graving dock 200 m. (656 ft.) long to take 10,000-ton vessels, on the Ile Cheviré, was authorized in 1923, but the work was stopped by the financial crisis. There is one slipway of 100 m. (328 ft.) length, which can be divided into lengths of 55 m. (180.5 ft.) and 45 m. (147.6 ft.) and is able to lift ships up to 1,800 tons or 18 tons per running metre, the vessels being hauled up broadside.

### *History*

Nantes is situated at a point where the Loire is joined by the River Erdre from the north and a little lower down by the Sèvre from the south. The heart of the city lies on a hill slope on the right bank of the Loire and on the left bank of the Erdre; the built-up area now extends for 6 km. along the Loire, and has spread on to the islands. The early construction of a bridge was facilitated at this point because the river originally split into three main branches.

In the Middle Ages Nantes had no great importance beyond its place as the largest town in Brittany; its prosperity dated from the discovery of America. Following a growth of trade, attempts were made to improve the depth in the Loire as early as 1596, and large vessels even of the seventeenth century had to lighten at Paimbœuf and Couéron. By 1704 Nantes was far and away the leading French port: it possessed 156 large ships and 1332 small craft, as against 73 and 463 at Marseilles and 29 and 64 at Bordeaux. In the eighteenth century the merchants of Nantes carried on most of the French traffic with the West Indies, while Nantes companies took the lead in developing Madagascar, and were also active in the India trade. It was then that the shipbuilding industry first became important, and that the city began its steady westward and downstream growth towards Chantenay. In this period of prosperity the fortunes of the city were closely connected with the water transport on the Loire which was to decline greatly with the coming of the railways. To deal with the growing problem of the navigable channel in 1864 a continuous dyke was built downstream from Le Pellerin, to narrow the



river and thus increase the scour; but this proved to be inadequate, and in 1869 the Martinière maritime canal was started. Completed in 1892, this canal ran from La Martinière for a distance of 15 km. downstream, and was navigable for vessels drawing 5·5–6 m. The improved shipping facilities made possible by the opening of this canal were reflected in the increase of trade from 350,000 tons in 1886 to over a million tons in 1900. Before the end of the century, however, the interest of the port authorities turned again to the natural channel, and further attempts, which have continued to the present day, were started to deepen the river. The Martinière Canal is no longer used.

In the past fifty years improvements of the port facilities have been made in response to the enlargement of the channel. Inclined quays were replaced by vertical quays, and recent decades have seen the construction of concrete quays and progressive reconstruction in reinforced concrete of the wooden quays. Since 1914 the quays along the Madeleine (or central branch), especially the right bank, have been used less. From 1914 to 1928, 1,715 m. of new quays with a depth of 7·5 m. (24·5 ft.) were built along the left bank (Bras de Pirmil). Nantes was the scene of considerable activity as a base port of the American armies in 1917–18. The floods of 1936 necessitated the raising of the surfaces of some quays while others have had to be reconstructed, as the deepening of the lower Loire and the removal of the old bridges reduced the level of low water at Nantes by 2 m. (6·5 ft.). The most modern quay is the Président Wilson. A tidal basin scheme was considered in 1933, but construction has not yet been started.

The islands of Nantes, unlike the islands of the Cité in Paris, were not the nucleus of settlement, for the city has expanded on to them in recent centuries. There were originally eight islands, through which the Loire wandered by a maze of channels. As the nineteenth century progressed, however, the tendency to abolish these channels, so as to drive more water into the main river, was reinforced by the high value of newly reclaimed land with a level surface in a growing industrial city. Thus these islands, regarded by some as the glory of Nantes, are being progressively converted by reclamation into one large island. This work began before 1800; in 1887 the islands of Prairie au Duc and St Anne were united by a large reclamation which provided a site for the Gare de l'Etat. A big scheme, carried out from 1924 to 1935, resulted in the Feydeau, Gloriette and Madeleine islands being united to the northern bank. The River Erdre has been

led through a tunnel for 722 m. to join the main stream by a shorter course, and its old lower course reclaimed. Altogether, the citizens of Nantes have wrought considerable changes in the original setting of their city (see Plate 30).

A considerable work now being undertaken is the improvement of the railway facilities. The line from the Orléans station downstream to Chantenay and St Nazaire, which runs along what was, until 1935, the right bank, passes through the heart of the city, and is thus badly placed for handling traffic. It is being displaced to the north side of the former Gloriette-Madeleine island and connected with the Orléans station by a bridge over the Canal St Félix. Much of the line, together with the Bourse station, will be underground. The Etat station will eventually be devoted entirely to goods traffic, and the Orléans station will become the general passenger station for the city.

At present there is only one road bridge leading to the south bank, while a transporter bridge connects the Prairie au Duc islands with the north bank at a point where the river is 183 m. (600 ft.) wide (this bridge gives a headway of 44.2 m. (145 ft.) at M.H.W.S.). A second bridge is projected, to cross the river a little upstream of the present one, and to form part of extensive road improvements.

### *Trade*

The trade returns for Nantes include the traffic passing through the subsidiary ports downstream.

#### *Cargo Movements, 1937 (thousands of tons)*

	Foreign trade			Coastwise total	Sea-borne total
	Imports	Exports	Total		
Nantes	1,581.4	516.6	2,098.0	376.4	2,474.4
Basse-Indre	122.9	28.8	151.7	16.0	167.7
Couéron	13.5	0.2	13.7	5.1	18.8
Paimbœuf	16.7	1.2	17.9	4.5	22.4
Donges	363.0	58.3	421.3	236.4	657.7
Total	2,097.5	605.1	2,702.6	638.4	3,341.0

Total foreign trade at Nantes, subsidiary ports and St Nazaire, 1938,  
provisional figures, 2,947.9.

The tonnage of goods traffic passing through the port rose from 1 million tons in 1900 to 2 million in 1913, and reached a peak of 3 million in 1916. Since that year it has fallen slowly to a figure of



2.1 millions in 1937. As with most French ports the imports exceed the exports considerably, being two or three times greater in most years. Half the imports are made up of coal, of which Great Britain supplies two-thirds, and Poland and Germany most of the remainder. Imports of foodstuffs are considerable, and include a large quantity of sugar together with other tropical products like coffee and cacao. Nantes is one of the leading French ports for the importation of rice. A big item is also the wine import from North Africa. Chemical raw materials make up a large tonnage, including mostly sulphur, pyrites and phosphates for the manufacture of fertilizers. The metallurgical industries of the Loire give rise to a small import of several metals. There is also an appreciable import of textile raw materials. The weight of exports consists mainly of metals and minerals in various forms. A considerable variety of manufactures, though small in weight, accounts for a high value. Other exports are of little importance.

Apart from the 'colonial' trade, Nantes has developed few specialized trades or overseas contacts, and the passenger or cargo liner services do not compare in number with those of Bordeaux and Havre.

### *Industries*

The city and its satellites, lying mostly downstream, now have a population approaching a quarter of a million, dependent mainly upon a variety of manufactures. Food-packing industries arise from the large local production of market-garden produce and lead to a subsidiary manufacture of tin boxes. Another group of industries have their roots in the colonial trade. Besides manufacturing tobacco, the city is one of the most important sugar-refining centres in France, although the trade suffered from competition by the beet sugar of the north; much of the production is sent to the wine-growing districts of the Médoc and Charente. It is, however, in the metallurgical, shipbuilding and engineering trades that Nantes has made most progress in the last fifty years. Shipbuilding is largely related to the industry at St Nazaire. The *Chantiers de la Loire* yards have four slips, up to 167.6 m. (550 ft.) in length, and important engine works. The *Bretagne* yards have four slips up to 132 m. (433 ft.) in length, besides a large engineering establishment. A third yard is the *Dubigeon*, with four slips up to 91.4 m. (300 ft.). This company builds mostly smaller types of ships, and has specialised in the construction of fishing vessels, tugs, and dredgers. Nantes is, however, more important for marine engineering than for shipbuilding,

and ranks with Paris in engine capacity. Along the Loire are various engineering works subsidiary to shipbuilding and ship repairing. A fairly recent development was the establishment during 1914-18, at St Joseph on the north-eastern fringe of Nantes, of a large plant for the manufacture of locomotives, a branch of the famous Batignolles firm of Paris; while in recent years the Government plan to decentralize the French aircraft industry led to the establishment of an aircraft factory at Bouguenais, which is one of the largest in France. The chemical industry is well established, and consists principally of the manufacture of superphosphates, which are dispatched to the farms of western France; Nantes is one of the two leading phosphate producers in the country. Miscellaneous industries include tanning, the manufacture of clothing and the production of interior fittings for the liners built at St Nazaire.

The maritime activities of the city are likely to be closely bound up with its industrial future. It has a favourable location for assembling coal and raw materials, but its hinterland offers no extensive market. Although Nantes lies far from the sources of hydro-electricity, the completion of the national grid may eventually make it economic for its industries to employ distant power. A further important factor in its industrial future is the outlook for the shipbuilding and allied industries, which will depend largely upon state policy. The chief economic problem of the port is the relative poverty of its hinterland in industrial and commercial activities: of all the principal French ports the inland connexions of Nantes are the most restricted. While this position cannot change very considerably, the tendency of the last ten years towards the decentralization of French industry, by leading to the development of such towns in the middle Loire as Bourges and Nevers, should increase the traffic of Nantes to some extent.

### *Communications*

The port is equipped with 35 km. of railways, which run on to all the quays. The Western Region of the S.N.C.F. provides connexions with Brest, St Malo, Paris, and central and south-western France. There is a canal to Brest, 360 km. long with a depth of 1.5 m. (5 ft.) and 219 locks, making possible connexions with the Rade de Brest, Lorient, Tréhiguier, and St Malo. Navigation on the Erdre was started in 1830 and a considerable amount continues; on the Loire there was formerly an active navigation reaching beyond Orléans, but the coming of the railway in 1850 practically brought



it to a standstill. Although the tides reach 20 km. above the city, navigation is difficult for the larger craft which are now employed on the main French waterways, owing to the irregular regime of the river. Traffic on the Loire and Erdre, consisting chiefly of limestone, slate, agricultural produce and wine, rarely exceeds 250,000 tons, and of this about four-fifths is carried on the Erdre. As the Loire is navigable only as far as Angers, there is no connexion with the main canal system of France. There are steamship services to London, Portugal, northern Europe, the West Indies and Spanish Main, Indo-China, West Africa and Morocco, as well as coasting services to practically every port on the French coast from Dunkirk to Bordeaux.

### SUBSIDIARY PORTS OF THE LOIRE ESTUARY

(See Fig. 27; Plate 28)

The smaller ports of the Loire estuary—Donges, Paimbœuf, Couéron, Basse-Indre, and Indret—fall into two distinct groups according both to their position and to their prospects. The downstream ports of Donges and Paimbœuf are oceanic and have an independent future, although their harbours are under the supervision of the Nantes authorities. The upstream river ports are subsidiaries of Nantes, near which they are situated, and they are subject to the same difficulties of approach for large ships.

Each of these ports on the lower Loire is largely used by a single industrial undertaking, such as an oil refinery or chemical works.

*Donges* is on the right bank, 10 km. above St Nazaire. Formerly there was only a mole, but in 1917 the construction of a jetty 350 m. long was started for the use of the American army and for the discharge of coal so as to relieve congestion at Nantes, but it was not finished till after the war. A project for using Donges as a deep-water coal port did not materialize, and in 1930 it was bought from the Orléans Railway by the state. There is a quay 365.7 m. long with 7.0–7.4 m. (23–24.5 ft.) depth alongside. Ships drawing 7–8 m. (23–26.25 ft.) frequently come to Donges without lightening, but a tank barge of 1,100 tons is available if lightening should be necessary. Installations for oil tankers were provided in 1920 and a refinery built in 1931. A wharf for petroleum vessels 330 m. long with 13–10 m. (42.6–32 ft.) at M.H.W.N. and 14.2–11.2 m. (46.5–36.6 ft.) at M.H.W.S. lies 0.8 km. below Donges wharf, providing three berths. There is a considerable stock of fuel oil which can be pumped into vessels at

the rate of 700–800 tons an hour. There are two petrol refineries; the annual output is increasing and in 1939 capacity amounted to 200,000 tons. Another company has storage tanks and a berth for discharging oil tankers 500 m. from the river bank, which can accommodate vessels of 7–7.9 m. (23–26 ft.) draught, while a third has a berth for bunkering vessels. The French government in 1939 was considering the construction of a pipe-line from Donges to either Montargis (south of Paris) or Dijon or possibly to both. The oil

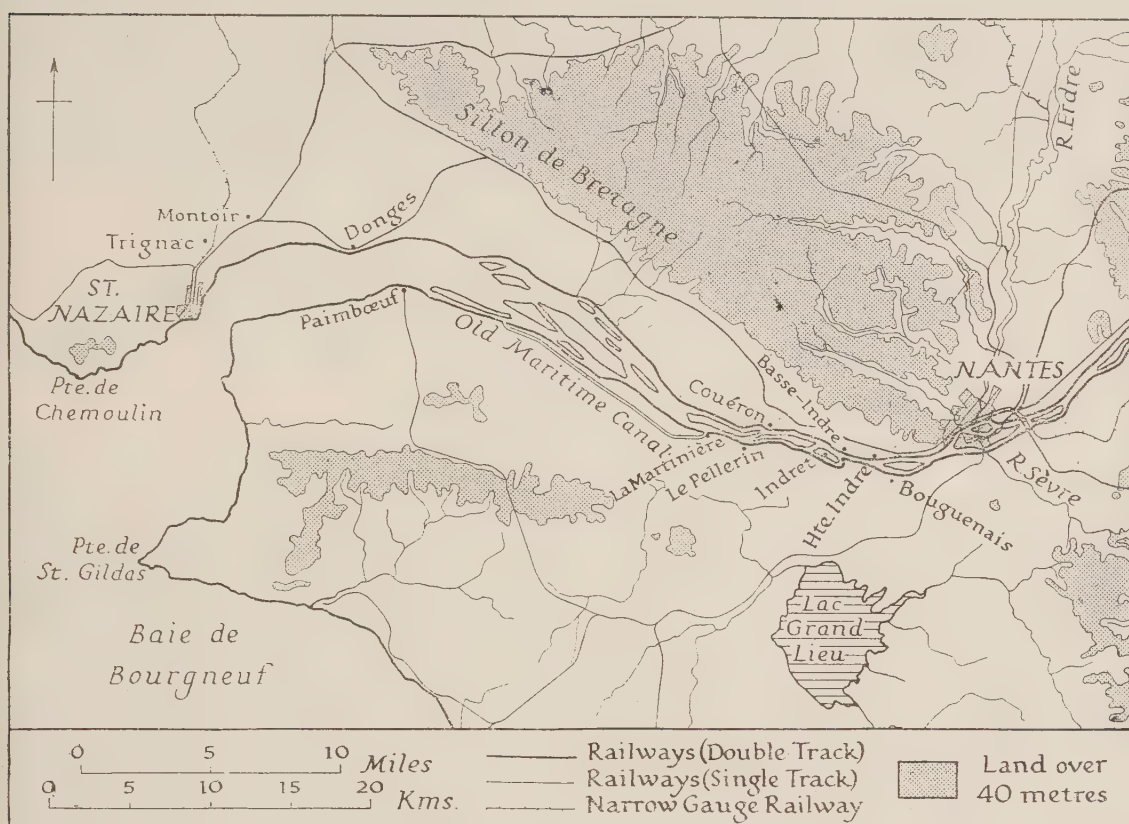


Fig. 27. The lower Loire

St Herblain, a small gasoline discharging berth, the enlargement of which was started in 1939, lies near Haute-Indre, on the north bank just below Nantes. It is now equipped to handle petroleum tankers.

imports in 1938 amounted to 130,000 tons. The site is rapidly becoming the most important in western France for discharging oil (see Plate 28).

*Paimbœuf* lies on the left bank opposite to Donges, 15 km. above St Nazaire. For long only a tiny fishing village, by the eighteenth century it had become an outport of Nantes. A graving dock was built in 1862, a vertical quay in 1878, and the estacade, now the property of *Etablissements Kuhlmann*, was built in 1917 by the *Poudrerie National de Ripault*. This wharf is 240 m. long and provides two berths with 8.0 m. (26.2 ft.) at M.H.W.N. and 10.5 m. (34.5 ft.)



at M.H.W.S. depth of water. The public quay, 183 m. long, provides two berths, on a draught of 7·8 m. (25·2 ft.) at M.H.W.N. and 9·3 m. (30·5 ft.) at M.H.W.S. There is a dry dock 80 m. (262 ft.) long and 15·7 m. (51·5 ft.) wide with sill 1·1 m. above datum and 5·4 m. (17·75 ft.) spring-tide rise. Paimbœuf specializes in the import of phosphates and pyrites for the local chemical works, and exports superphosphates, but other traffic consists only of river and coasting steamers. Labour is cheaper at this harbour than at the other Loire ports. Phosphates can be discharged at about 600 tons per day, and burnt pyrites loaded at about 500 tons per day. There are six small cranes.

*Couéron*, on the right bank 18 km. below Nantes, is a very old port, which became the outport of Nantes in the eighteenth century. The large copper and lead-smelting plant (Pont Gibaud works) has a wharf with two berths and 5·6 m. (18·5 ft.) and 5·9 m. (19 ft.) depths alongside, equipped with three cranes. A wharf 121·9 m. long, alongside which vessels drawing 6·7 m. (22 ft.) can berth, is equipped with continuous loading apparatus. The quays were begun in 1843 and the present estacade built in 1919.

*Basse-Indre*, 3 km. above Couéron on the right bank, is a port of call established in 1844, with stone wharves at the low-water mark. Until the establishment of the Indret iron works in the middle of the nineteenth century, the population were mainly fishermen. The landing stage, 1,400 m. in length, was constructed in 1884, and the wharf of the *Forges de Basse-Indre* in 1928. The iron works have a wharf 76 m. long and with 6·5 m. (21·3 ft.) depth alongside, equipped with two cranes; and a more modern wharf, 134·1 m. long, permitting a draught of 7·6 m. (25 ft.), equipped with continuous iron-ore loading apparatus. The modern concrete quay of the *Cie Bordelaise de Produits Chimiques* lies between Basse and Haute-Indre, 10 km. from Nantes; it is 52·7 m. long and has 7 m. (23 ft.) depth alongside at low water: it is equipped with two cranes.

*Indret*, on an island abreast of Basse-Indre, and with an anchorage of 3·4 m. (11 ft.) depth, has a government machinery and boiler works. The quays of Couéron and Basse-Indre are linked to Nantes by a bus service.

At *St Herblain*, just below Nantes, on the north bank, the government in 1939 had undertaken the construction of a new petroleum discharging wharf which had been in use. A small discharging berth for gasoline had been in operation for some years.





Plate 29. Nantes: Qui d'Aiguillon (looking north-east, upstream)

To the left on the north or right bank are the Quai Ernest-Renaud followed by the Quai de la Fosse; to the right on the south or left bank is the Quai des Antilles, followed by the *Ateliers et Chantiers de la Loire* and *Ateliers et Chantiers de Bretagne* shipyards, which extend as far as the Transporter Bridge in the distance. (For map see p. 115.)



Plate 30. Nantes: the Loire above the Transporter Bridge (looking north-east)

Beyond the bridge the white area shows the former north branch of the river which has been reclaimed so as to unite the north bank and the Ile Gloriette; the Bras de la Madeleine can be seen bearing off to the right. The Cathedral and Château appear on the skyline. (For map see p. 115.)





Plate 31. La Pallice: Avant-Port (looking west-north-west)

On the right, in the background, can be seen the liner mole (during the period of construction) and the connecting viaduct, while across the roadstead is the Ile de Ré. (For map see p. 126.)



Plate 32. La Rochelle (looking north-west)

In the foreground is the large Bassin à Flot Extérieur, the principal section of the port for larger vessels; the photograph was taken when the extension of the dock was still in progress. A vessel can be seen in the avant-port. In the central foreground is the goods station, formerly the town station. The belt of trees marks the site of the old fortifications. (For map see p. 128.)



## LA ROCHELLE AND LA PALLICE

(See Figs. 28, 29, 30; Plates 31, 32)

### *General Description*

The old port of La Rochelle (pop. 48,000) and the deepwater port of La Pallice, 6 km. to the west, lie in the north-eastern corner of the Pertuis d'Antioche, sheltered to a large extent by the islands of Oleron and Ré. La Rochelle is the second fishing port of France, judged by the annual value of the catch.

The two ports can be approached either from the north-west, through the Pertuis Breton, or from the south-west across the

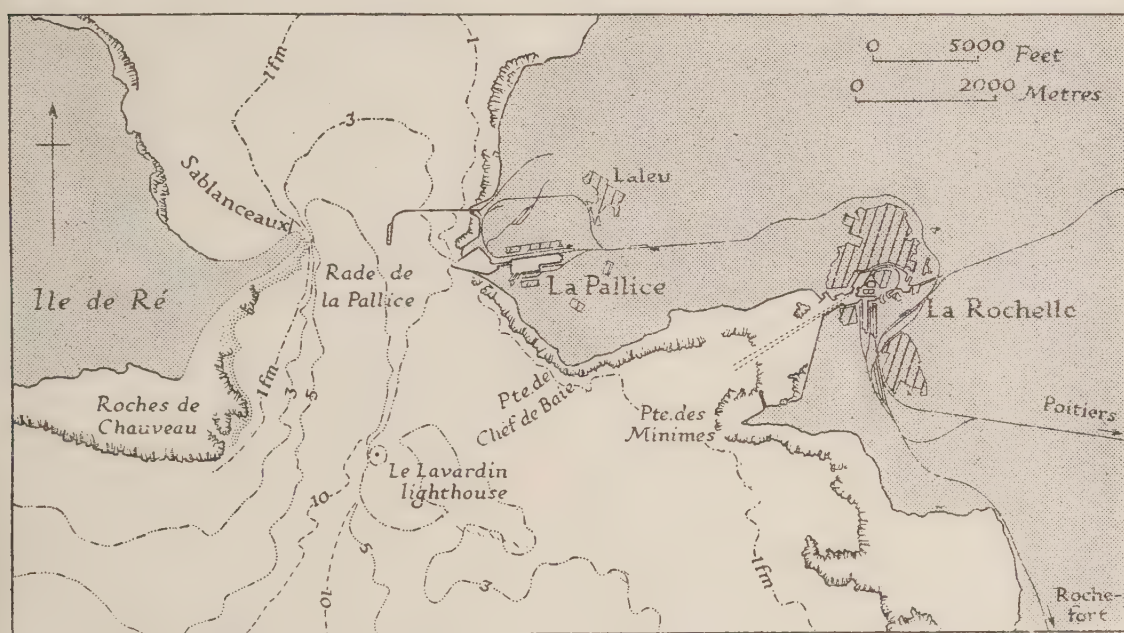


Fig. 28. The approaches to La Rochelle and La Pallice

Pertuis d'Antioche; the latter course is the more usual one, especially for large vessels, which can enter La Pallice at all states of the tide. La Pallice roadstead is in fact the best anchorage between the Loire and the Gironde, and the port has the deepest water of any port on the French Atlantic coast except the new port of Le Verdon. The tidal flood stream flows northwards through the Rade between the mainland and Ré island, and ebbs southward, but in neither case does the speed exceed  $2\frac{1}{2}$  knots. The most awkward conditions for navigation arise when a strong south-westerly wind encounters the south-west-flowing ebb tide, causing choppy water. The eastern side of the Pertuis d'Antioche is encumbered with shoals and the approach to La Rochelle is made by a narrow channel only 35 m. (115 ft.) wide, with a depth in places of only 0.9 m. (3 ft.) at the lowest tides.



La Pallice can accommodate the largest vessels afloat at its new mole, and its wet dock can take vessels up to 170 m. (558 ft.) length and 21 m. (69 ft.) beam, with 8 m. (26.3 ft.) draught at M.H.W.N. The port has nineteen berths. La Rochelle, on the other hand, though adequate a century ago, has no facilities for large vessels, and can only be entered at high water. The maximum length and beam of vessels which can be accommodated are 100 m. (328 ft.) and 15.5 m. (51 ft.) respectively. There are eleven berths for sea-going ships in the outer wet dock, but large numbers of fishing vessels can also be accommodated.

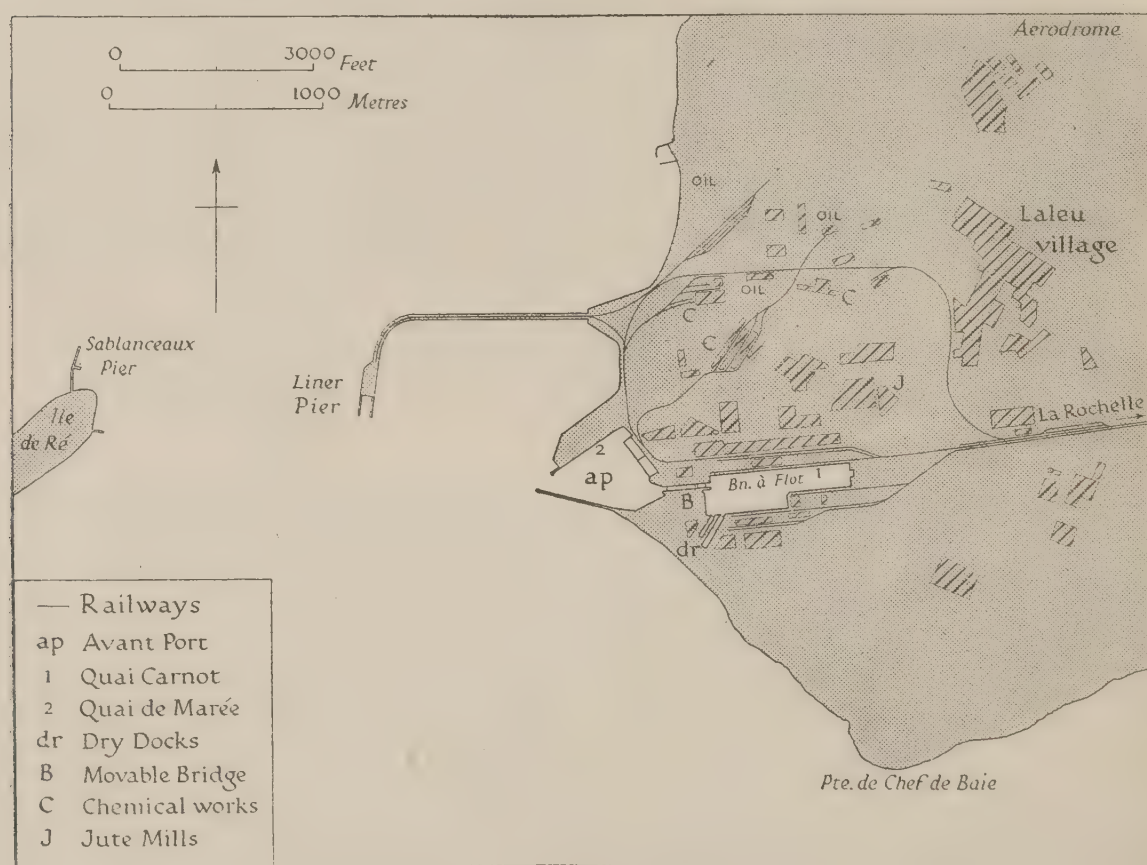


Fig. 29. La Pallice

The liner 'pier' is actually a solid structure, better described as a 'mole'. It is shown before the completion of the filling in. The buildings near the eastern margin of the map, south of the railway line, are chemical works.

### *Detailed Description—La Pallice*

La Pallice comprises an avant-port, a wet dock, and a calling mole for liners. The entrance to the avant-port is 90 m. wide between the heads of the two jetties. Within the avant-port, the Quai de Marée and the wharf on the eastern side are berthable, but only a short section of the 626 m. long southern jetty is constructed as a quay, and even here westerly winds are apt to cause a big swell. The wet

dock is entered by a lock 235 m. (771 ft.) long, 21.5 m. (70 ft.) wide, and with a depth on sill at M.H.W.S. of 9.8 m. (32.2 ft.); the dimensions of vessels which can use this dock are limited to 170 m. (558 ft.) length and 21 m. (69 ft.) beam. The new liner mole lies at the end of a long steel viaduct, 1,120 m. long and 10 m. wide, which carries a motor road and railway track. The mole itself is roughly 300 m. in length and 60 m. wide; a maritime railway station will be constructed on it eventually.

Details of the accommodation at La Pallice are as follows:

	Quay length - m.	Maximum ap- proach draught M.H.W.S.		Maximum draught at lowest water M.H.W.N.		Berths
		m.	ft.	m.	ft.	
Avant-port:						
Quai de Marée	374	10.2	33.5	8.5	28.0	—
East wharf	201	10.2	33.5	7.0	23.0	1
South jetty	105	10.2	33.5	6.5	21.3	2
Liner mole:						
East face	280	15.7	51.5	10.5	34.5	2
West face	240					
				draught M.H.W.S.		
Bassin à Flot	1,700	9.2	30.2	8.0	26.2	13
Total	2,900					18

### Port Facilities

There are thirty-seven cranes with a capacity under 10 tons at La Pallice. Discharging equipment also includes a grain elevator, while four oil pipe-lines lead to the extensive storage tanks. There are two dry docks, entered from the south-western corner of the wet dock; the larger of the two is 176 m. (577 ft.) long and 22 m. (72 ft.) wide. They are well served by powerful cranes, four in number, of which the largest has a capacity of 40 tons.

### Detailed Description—La Rochelle

La Rochelle comprises an avant-port, or outer harbour, a stranding basin (Havre d'Echouage), and two wet docks. The avant-port is well sheltered; a depth of water of between 0.3 m. (1 ft.) and 0.9 m. (3 ft.) over the soft mud bottom is maintained by sluicing. The stranding basin, covering 3.3 ha., is the oldest part of the port, and is bordered by picturesque quays. It is entered from the avant-port by a passage 25 m. (82 ft.) wide between the two towers of La Chaîne and St Nicolas. Its quays are used by fishing boats which ground



on the mud at low tide, and by the passenger steamers which serve the islands of Ré and Oleron. At the north-easterly corner of the basin is a lock giving access to the Maubec reach of the Marans Canal; there is little or no traffic on this canal now, and the lock is

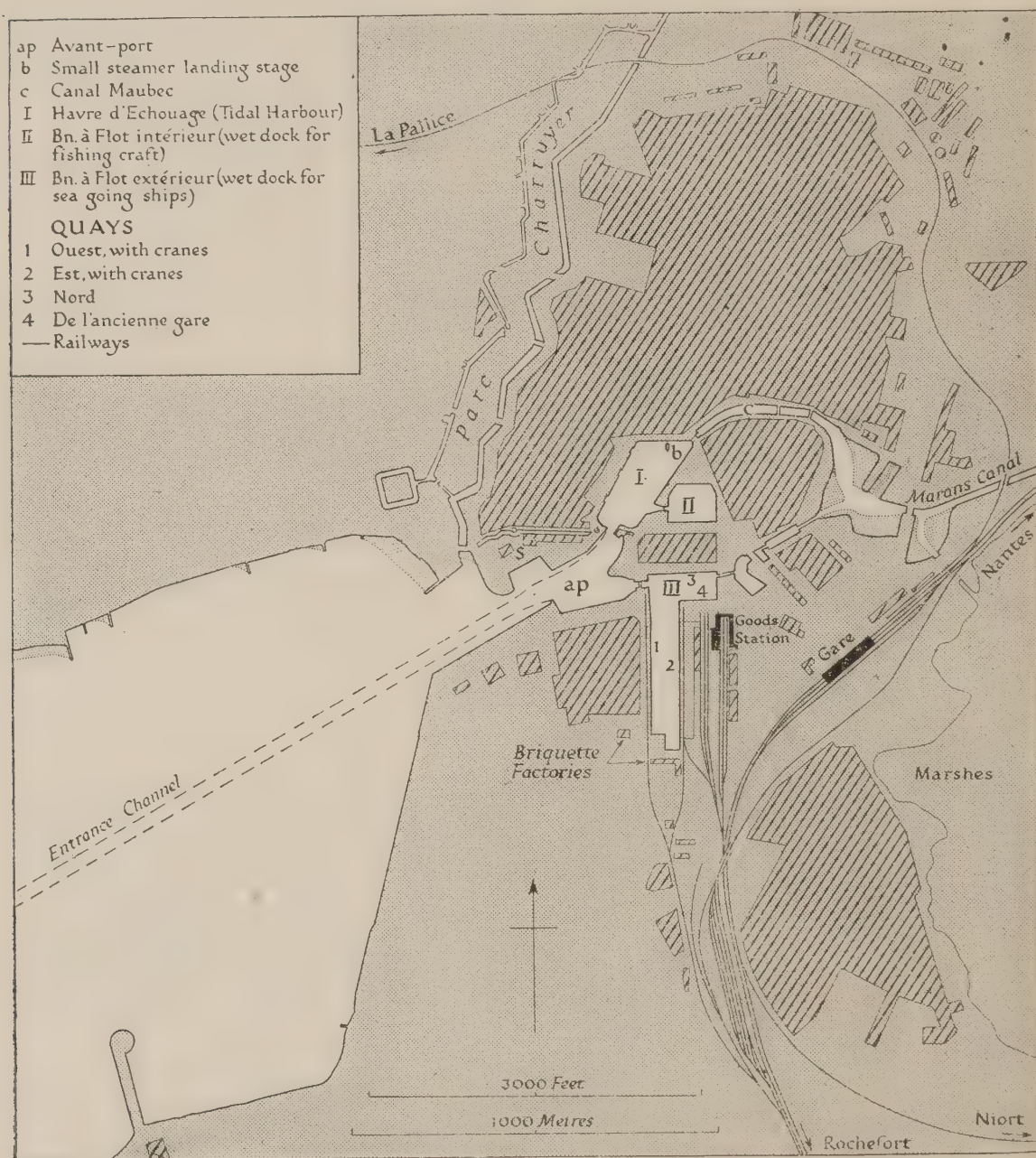


Fig. 30. La Rochelle. S, shipyard.

used at low water for the admission of sluicing water to the stranding basin and avant-port. The inner wet dock (Bassin à Flot intérieur), covering 1.35 ha., is entered from the stranding basin by a dock gate 12.2 m. (39 ft.) wide. The only part of the port used by sea-going ships is the outer wet dock (Bassin à Flot extérieur), covering 5 ha. and entered from the avant-port by a dock gate which limits the

length of ships entering to 100 m. (328 ft.) and the beam to 15.5 m. (51 ft.). Berthing facilities at the port may be summarized as follows:

	Quay length m.	Access draughts M.H.W.S.		Access draughts M.H.W.N.		Berths
		m.	ft.	m.	ft.	
Bassin à Flot extérieur:						
Quai Nord	190	6.2	20.5	5.0	16.4	2
Quai Ouest	400					4
Quai Est	400					4
Quai de l'ancienne gare	100					1
	1,090					11

### *Port Facilities*

There are twelve cranes of under 10 tons capacity at La Rochelle. Repairing equipment consists of a careening grid in the north-eastern corner of the stranding basin, 75.4 m. (247 ft.) long and 10.2 m. (33.5 ft.) wide.

The combined port of La Rochelle-La Pallice possesses 35,250 sq.m. of warehouse space, and a further 117,400 sq.m. of storage space on and behind the quays.

### *History*

The town of La Rochelle still retains numerous buildings and other relics dating from the heroic age when it stood as a bulwark of Protestantism against the Catholicism of the French Monarchy. A considerable section of its old fortifications remains, and the Hôtel de Ville (Town Hall), founded in 1289, rebuilt in the sixteenth century and restored in the 1870's, is the most striking architectural feature.

Before the twelfth century La Rochelle was only a small fishing port, dependent on the barons of Châtelailon, but the destruction of that stronghold in 1127 opened the way for its development. For over two centuries it lay alternately in French and English hands; from 1152 to 1226 it belonged to England, and again from 1360 to 1372. Then it became one of the leading French ports; from its quays Jean de Béthencourt sailed in 1402 to conquer the Canary Islands, and its mariners were amongst the first to profit by the discovery of North America. The founders of Montreal embarked here, and many Canadian colonists followed them. The religious wars of the sixteenth century put an end to the period of prosperity, for La Rochelle was



a centre of Protestantism and had to suffer in consequence. The town was besieged by the royal army for over six months in 1572, after a body of Huguenots had taken refuge there, and then in 1628-9 it suffered another siege of nearly 15 months' duration, at the hands of Louis XIII and Richelieu. Capitulation only came when scarcely an able-bodied man remained and the population had been reduced from 27,000 to 5,000.

Deprived of its ancient privileges of free trade, and exhausted by its sufferings, La Rochelle could do little but provide a port of embarkation for Canadian colonists. The Revocation of the Edict of Nantes in 1685 was another blow to this stronghold of Protestantism, but the port was refortified by Vauban and its fortunes revived in the eighteenth century as colonial trade developed. A Chamber of Commerce was formed in 1719, and between 1728 and 1740 improvements to the port were carried out, including two sluicing basins and a groyne to reduce shingle accumulation. The cession of Canada to England in 1763 and the purchase of Louisiana by the United States in 1803 cut off a great part of La Rochelle's colonial trade, and improvement works which had been started in the 1760's were also delayed by the Revolution. The first wet dock was opened in 1808. Subsequently the port began increasingly to develop the fishing industry, while the expansion of trade in the middle of the century was aided by the construction of the railway from Poitiers in the early 1850's and the opening of the second wet dock in 1864. The facilities, in fact, were rapidly becoming inadequate as the size of vessels increased, and in 1873 the Chamber of Commerce decided upon the creation of a new deepwater port at La Pallice, the work being executed during the decade 1881-91. The new port proved of considerable value during the war of 1914-18, for the Americans used it as a military and naval base.

Both La Rochelle and La Pallice have been improved during the last two decades. A length of new quay was added to the large wet dock at La Rochelle for fishing vessels in 1924-5, whilst at La Pallice in 1931 work began on the construction of a deepwater calling mole, linked to the mainland by a long viaduct. This was sufficiently complete to be usable by the largest liners in 1940. The plan of expansion at La Pallice included the laying out of an aerodrome as an additional attraction for trans-oceanic passenger traffic.

*Trade and Industry**Cargo Movements, 1937 (thousands of tons)*

	La Pallice	La Rochelle
Foreign trade: Imports	553.9	263.9
Exports	72.1	72.2
Total	626.0	336.1
Coastwise trade (total)	56.7	31.3
Total sea-borne trade	682.7	367.4
Total foreign trade in 1938 (La Pallice and La Rochelle), provisional figures	923.8	

Apart from the exceptional traffic of the years 1917-18, the greatest tonnage of freight passing through the two ports was 1,200,000 tons in 1930. Imports greatly exceed exports, and a large proportion of the commodities entering the ports is destined for use in local industries. About one-half of the tonnage is made up of coal—mostly British—destined for use in local factories, for bunkering the local fishing fleet and vessels which call, for the railway and for domestic use. Other imports related to local industry are North African phosphates, Spanish pyrites, and Chilean nitrates—all of which are used in the chemical and fertilizer works at La Pallice; oil for the storage accommodation at La Pallice, pitch for the briquette factories, jute for the mills at La Pallice, mistelle for use in the making of cognac in the Charentaise region, Scandinavian timber largely used in the making of wine barrels, and sulphate of ammonia for the agricultural hinterland. Some grain and flour are imported, especially rice.

The exports are few, for local industry finds its market within the agricultural hinterland. The burnt pyrites from the chemical works is exported for use as an iron ore, while there is some export of local timber in the form of pit-props, and also of locally produced wine, brandy and casein.

Almost all the export trade is handled by La Pallice. La Rochelle devotes much of its harbour space to the fishing industry. The combined port possesses over 750 fishing boats, of which over 300 are mechanically propelled; their gross tonnage amounts to about 18,000. About 2,600 fishermen are engaged, and the value of the catch places La Rochelle-La Pallice second only to Boulogne in the list of French fishing ports. Twelve large trawlers are based on La Pallice; they exploit the cod fisheries of Newfoundland and south-west Greenland. The 'pêche hauturière' of La Rochelle, accommodated in the outer wet dock, has eighty steam trawlers fishing for hake, etc., on the



continental banks of Iceland and Morocco. There are also considerable coastal fisheries for turbot, sole, tunny, lobsters, and crabs.

### *Communications*

The Marans Canal (see pp. 443-4) leads in a north-easterly direction for 24 km. to Marans; but it is no longer of any significance for traffic.

La Pallice is the terminus of Route Nationale 22 which runs through La Rochelle and then north-eastwards to Paris via Niort; another main road leads to Rochefort, and the hinterland is fairly well covered by a network of roads of less importance.

The wet dock and the new mole at La Pallice have standard-gauge railway tracks connected with the single-track line which runs eastwards to La Rochelle. At the latter port the quays of the outer wet dock are served by railway tracks. Considerable rearrangement of the main railway lines at La Rochelle was undertaken in the 1920's, and the old passenger terminus on the eastern side of the outer wet dock was converted into a goods depot, a new station being constructed farther east, thus doing away with the necessity of reversing trains proceeding in a north-south direction between Nantes and Bordeaux. A new marshalling yard was also constructed. La Rochelle lies at the meeting point of lines from La Roche-sur-Yon (and Nantes), from Niort (and Poitiers), and from Rochefort (and Bordeaux), and in normal times is well served by express trains to Paris, and is an important halt on the main route which connects St Malo on the Channel coast with Bordeaux and the Spanish frontier.

Local steamship services connect La Rochelle and La Pallice with the islands of Ré, Aix and Oleron. From the Quai Duperré in the stranding basin at La Rochelle, regular services, timed according to the tides, sail to La Flotte and St Martin de Ré on Ré island, and via Aix island to Boyardville on the island of Oleron. From the avant-port at La Pallice a more frequent service crosses the roadstead to Sablanceaux pier at the south-eastern end of Ré island.

## ROCHEFORT

(See Figs. 31, 32)

### *General Description*

The shipbuilding centre and former naval base of Rochefort (pop. 29,000) is situated 15 km. up the river Charente, which flows into the south-eastern corner of the Pertuis d'Antioche.

The approach to the mouth of the Charente is made through the Rade de l'Ile d'Aix between the islands of Aix and Oléron. The estuary, which is aligned in a north-west-south-east direction, is about 8 km. long from its entrance between the rocks of Le Chiron and Le Porterat to the mouth of the actual river between Fort de la Pointe and Le Port des Barques. The navigable channel narrows considerably between Ile Madame and Fouras owing to the extent of the shoals which dry at low tide.

The river, especially above the large meander, the southern bank of which is known as Pointe de la Sablière, is narrow and sinuous

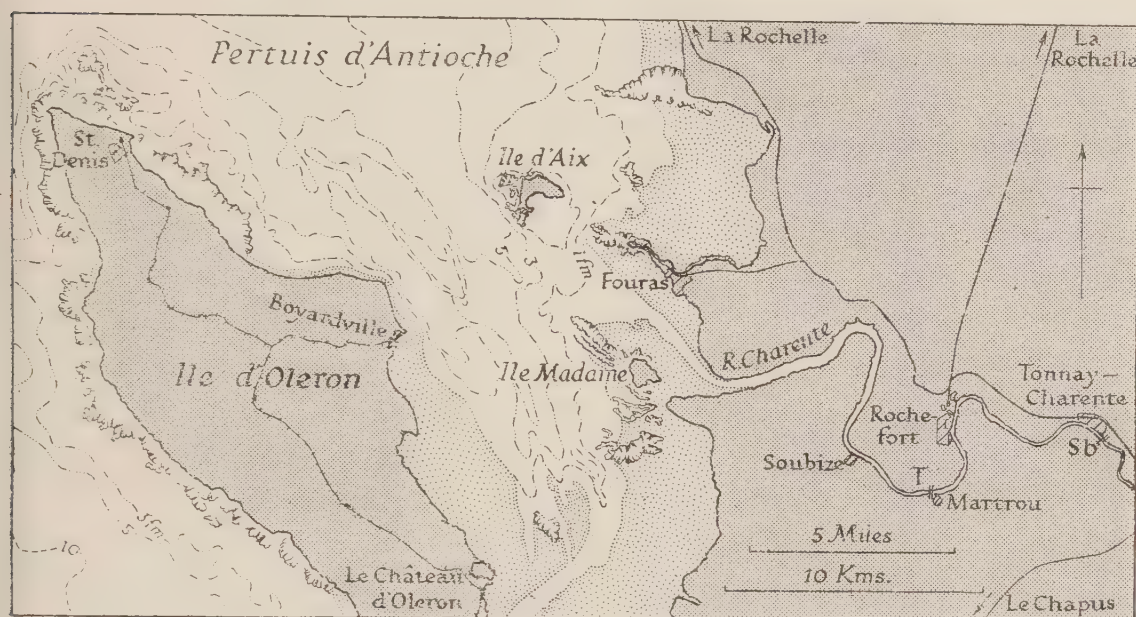


Fig. 31. The Charente Estuary and approaches  
Sb, Suspension Bridge; T, Transporter Bridge.

and at low tide has only a few feet of water. Access can be made on draughts of 5.6 m. (18.5 ft.) at M.H.W.N. and 7.0 m. (23 ft.) at M.H.W.S. Manœuvring round the bends is a delicate operation, and vessels longer than 145 m. (476 ft.) are thus prohibited from using the river. Vessels which cannot make the passage of the narrow river during one high-water period can lie in the mud at Soubise or at Martrou. The transporter bridge at Martrou allows a minimum headroom of 50 m. (164 ft.). The width of the river at Rochefort is about 120–125 m.

The greatest depths that can be relied upon either in the military or the commercial section of the port is 8 m. (26 ft.); the largest lock giving access to the wet docks of the commercial port is 104 m.



(341 ft.) long and 18 m. (59 ft.) wide. There are seventeen berths in the commercial port.

### *Detailed Description*

Rochefort lies on the higher right bank of the river, which is here, in the course of a large meander, flowing north-south. The 'military port', including the former naval shipbuilding yards now in private

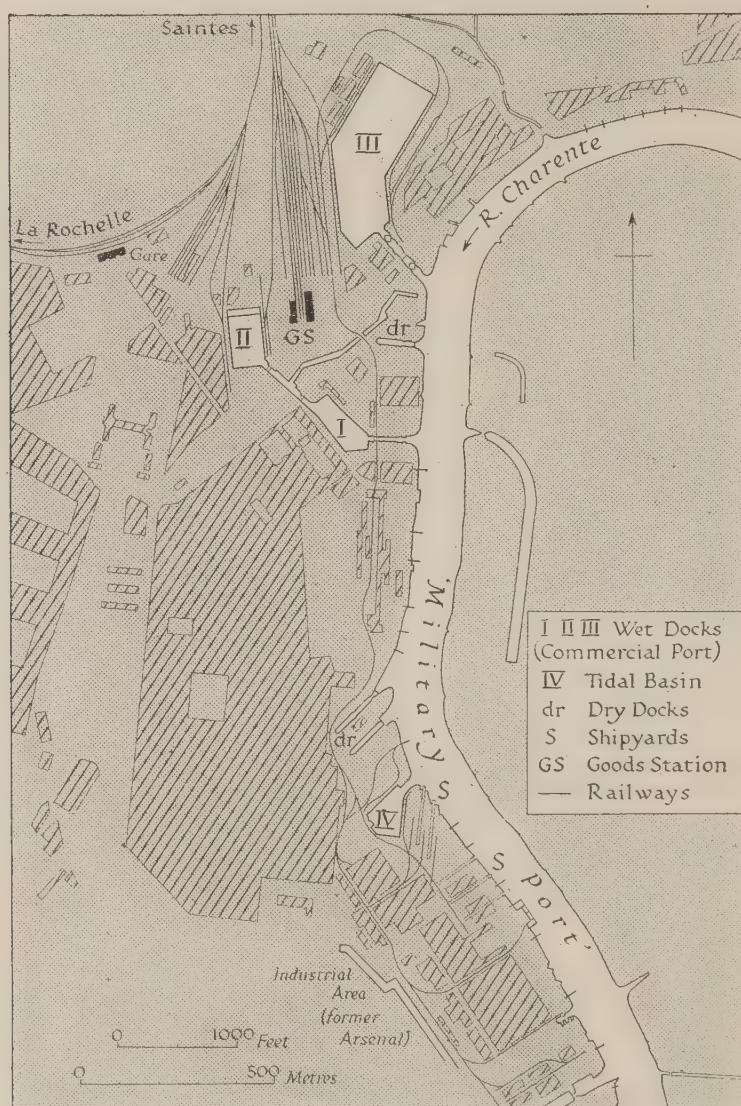


Fig. 32. Rochefort

ownership, extends for about 1.7 km. along the river bank, east of and below the town. The commercial port lies north of the town, immediately above the military port.

The 'military port' consists of lengths of quays with short wooden piers projecting into the river at intervals, a small stranding basin and a number of building slips and dry docks. Vessels can lie alongside the quays in 7-7.9 m. (23-26 ft.) of water.

The commercial port consists of three wet docks. No. 1, covering 1.1 ha., is entered from the river by a lock which imposes limits of 90 m. (295 ft.) length and 13.5 m. (44.2 ft.) beam. A passage connects this dock with no. 2 which covers 1.25 ha.; limits on the dimensions of vessels entering this basin are the same as those for no. 1. The largest dock, no. 3, covering 6.5 ha., is entered 400 m. upstream from the entrance to no. 1. Limits imposed by its entrance lock are length 145 m. (475.7 ft.) and beam 17.5 m. (57.3 ft.). The maximum draught for entry is 5.6 m. (18.5 ft.) at M.H.W.N. and 6.2 m. (20.5 ft.) at M.H.W.S. The following table summarizes details of the docks:

Basin	Quay length m.	Berths	Minimum draught		Use
			m.	ft.	
Wet dock no. 1	400	2	5	16.5	Coasters, Charente barges
Wet dock no. 2	480	6	5	16.5	Timber, coal
Wet dock no. 3	1,200	9	6.5	21.3	Timber, coal, phosphates
Total	2,080	17			

Warehouse space covers 6,900 sq.m., and there is additional storage space on and behind the quays to the extent of 85,000 sq.m.

### *Port Facilities*

The port is equipped with sixteen cranes under 10 tons. There are three dry docks in the 'military port', the largest of which is 140 m. (459 ft.) long, and with a width at the entrance of 18.4 m. (60.4 ft.) and depth on sill at M.H.W.S. of 6.8 m. (23.3 ft.). Another dry dock, 100 m. (328 ft.) long and 13 m. (42 ft.) wide, exists in the commercial port, where there are also a gridiron and a patent slip.

### *History*

Rochefort is situated partly on a chalk bluff overlooking a large meander of the river Charente and partly on the low ground bordering the river. The old town, which is characterized by a rectangular street pattern, is sharply divided from the more modern westward extensions by wooded avenues and open spaces which occupy the site of the old fortifications.

The ancient fortress which gave its name to Rochefort was built as a defence against Norman invaders, and a small town grew up



under its protection in the eleventh century. The lordship of Rochefort was united to the French crown by Philip the Fair early in the fourteenth century, but it was for some time the subject of dispute between the English and the French during the Hundred Years' War. In the Wars of Religion, Rochefort was again in debatable territory, being held alternately by Catholics and Protestants. In 1665 Colbert selected the port as a repairing base between Brest and the Gironde, and in the next few years the *port militaire* and arsenal and a new fortified town were laid out on geometrical lines. The town rapidly increased in importance and by 1674 it had 20,000 inhabitants. Soon after a Dutch fleet of seventy-two vessels under Cornelius Tromp approached Rochefort in order to destroy the new arsenal but withdrew owing to the strength of the defences. A naval school was founded, eventually to be transferred to Brest. In 1690 and 1703 the English made unsuccessful attempts to destroy it. It was a fleet based upon Rochefort, under the command of Admiral la Gallissonnière, a native of the town, which defeated Admiral Byng in 1756. Its fleets played an important part in the naval activity of the American War of Independence and the Anglo-French struggles during the Republic and First Empire. Napoleon stayed at Rochefort in 1815 before embarking on the *Bellerophon* at Ile d'Aix.

The Napoleonic period, however, marked the turning point in the fortunes of the town. In 1809 a French fleet had been destroyed by the English in the roadstead of the Ile d'Aix. The naval authorities gave more and more preference to the harbours of Brest and Toulon, and the unhealthiness of its position further interfered with the prosperity of Rochefort. The railway reached the town in the early 1850's from La Rochelle, but with the rapid increase in the size of vessels the difficulty of navigating the winding river began severely to handicap Rochefort as a naval base. It was superseded as the principal French naval base by Brest, and eventually, in 1928, much of the space in the arsenal and shipyards were turned over to private industrial enterprise.

### *Trade and Industry*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	169.9
Exports	0.3
Total	170.2
Coastwise trade (total)	16.4
Total sea-borne trade	186.6

The three main commodities dealt with in the commercial port are timber, coal, and tar. Wet docks nos. 2 and 3 each have a special inclined slip at their ends for unloading timber; a briquette factory utilizes the tar and some of the coal. The shipbuilding which was so important whilst Rochefort was a great naval base has practically ceased, though five building slips remain. The activities of the arsenal, including the seventeenth-century rope works, have also ceased, except for a training school, some workshops and part of the naval ordnance works. Their place has to a certain extent been taken by a factory of the nationalized aircraft industry and by the setting up of a School of Maritime Aeronautics (Naval Air Service). There is also a factory manufacturing balloons and parachutes.

### *Communications*

The river Charente is navigable for sea-going vessels to Tonnay, and for barges to Cognac, 84 km. above Rochefort. Downstream, apart from coastwise and foreign traffic, a regular passenger service is run to Boyardville on Oleron island, 38 km. distant.

Rochefort is a focus of Routes Nationales; it is the terminus of R.N. 11 from Paris and has other roads leading to La Rochelle, St Jean d'Angely, Saintes, Royan, and Le Chapus. It was formerly served by two railways, the Etat and Paris-Orléans, but as a result of the nationalization of the French railways in 1938, its services have been simplified. It falls within the Western Region of the S.N.C.F. The wet docks, nos. 2 and 3, and the arsenal are connected by standard-gauge tracks to the main line. This main line runs from La Rochelle to Bordeaux, passing through Rochefort. Connexion with Paris is made via La Rochelle and Niort to Poitiers, where the South Western Region electrified main line is joined. A short branch from the La Rochelle line runs to the small port and resort of Fouras; the line to Le Chapus (for Oleron island) diverges from the Bordeaux line at Cabariot, above Tonnay. The former P.-O. direct line from Rochefort terminus (now converted into a goods depot) to La Rochelle has lost its passenger service as far as Aigrefeuille-le-Thou; this has been replaced by road vehicles.

## TONNAY-CHARENTE

(See Plate 33)

Tonnay (pop. 4,500) lies on the right bank of the river Charente, 6 km. above Rochefort, and at the head of navigation for sea-going vessels. The river is navigable for barges for a further 78 km. to



Cognac, but the Tonnay suspension bridge, which leaves only 21.9 m. (72 ft.) head-room at the highest tides, provides a further limit for sea-going vessels quite apart from decreasing depths of water above this point. Owing to the sharp bend just above the commercial port of Rochefort, the lengths of vessels which can navigate the Charente to Tonnay is limited to 90 m. (295 ft.), and the width of the river at Tonnay—scarcely 80 m.—is a further limiting factor. Vessels of between 300 and 1,000 tons are regular visitors to the port, but steamers of 4,000 tons, drawing 6.4 m. (21 ft.), can actually be received at highest spring tides when the depth of water reaches 7 m. (23 ft.); the normal draughts are 5.2 m. (17 ft.) at H.W.L.N., 5.5 m. (18 ft.) at M.H.W.N., and 5.8 m. (19 ft.) at M.H.W.S. All vessels lie aground at low water.

The port extends for about 1.5 km. along the river bank below the suspension bridge. There are six berths on a draught of 5.5 m. (18 ft.), each of which is alongside a wharf built out from the river bank. The brandy and general cargo trade is dealt with at the Quai de Commerce, which is served by railway tracks but has no cranes; there are three berths. Adjacent to the railway station are three wharves owned by S.N.C.F. Western Region, for discharging coal and other bulky goods such as timber; close by is a private wharf belonging to the St Gobain chemical fertilizer works, utilized for discharging phosphates and loading superphosphates. All these wharves are equipped with six cranes of under 10 tons capacity. They are connected by railway to the station yard. The total length of quays accessible to sea-going vessels is 577 m.; there are 1,980 sq.m. of warehouses, and 2,500 sq.m. of storage space on the quays.

*Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	196.1
Exports	42.9
Total	239.0
Coastwise trade (total)	9.8
Total sea-borne trade	248.8

The chief imports at Tonnay are coal and coal tar for local use, for shipping and railways, and for briquette manufacture, phosphates and pyrites for the chemical and fertilizer works, and cereals. Exports include brandy, burnt pyrites and superphosphates. Tonnay is served by the main line of railway linking Rochefort (and so La Rochelle and Nantes) with Saintes (and so Bordeaux).





Plate 33. Tonnay-Charente (aerial view)

The view illustrates the character of this small port, in which several wharves extend from the river bank. The railway bridge marks the upstream limit of navigation. (The side margins of the photograph run roughly north and south.)



Plate 34. Le Verdon: The Liner Pier (looking north-north-west)

The liner *Champlain* (28,000 tons gross) is alongside the outer face. To the left, the low southern shore of the Gironde estuary culminates in Pointe de Grave, on which stands the American memorial of the war of 1914-18; in the distance, the north shore runs westwards to Pointe de la Coubre. The deep water channel from the pier leads to a point close to the distant shore before turning westwards and entering the Bay of Biscay by the Grande Passe de l'Ouest. (For map see pp. 140, 142.)





Plate 35. Pauillac: petroleum discharging installation (looking east)

From the wharf pipe-lines lead directly to the Pauillac refinery. The deep-water tanker wharf lies beyond the short L-shaped pier, which is now used by coasting craft. (For map see p. 143.)

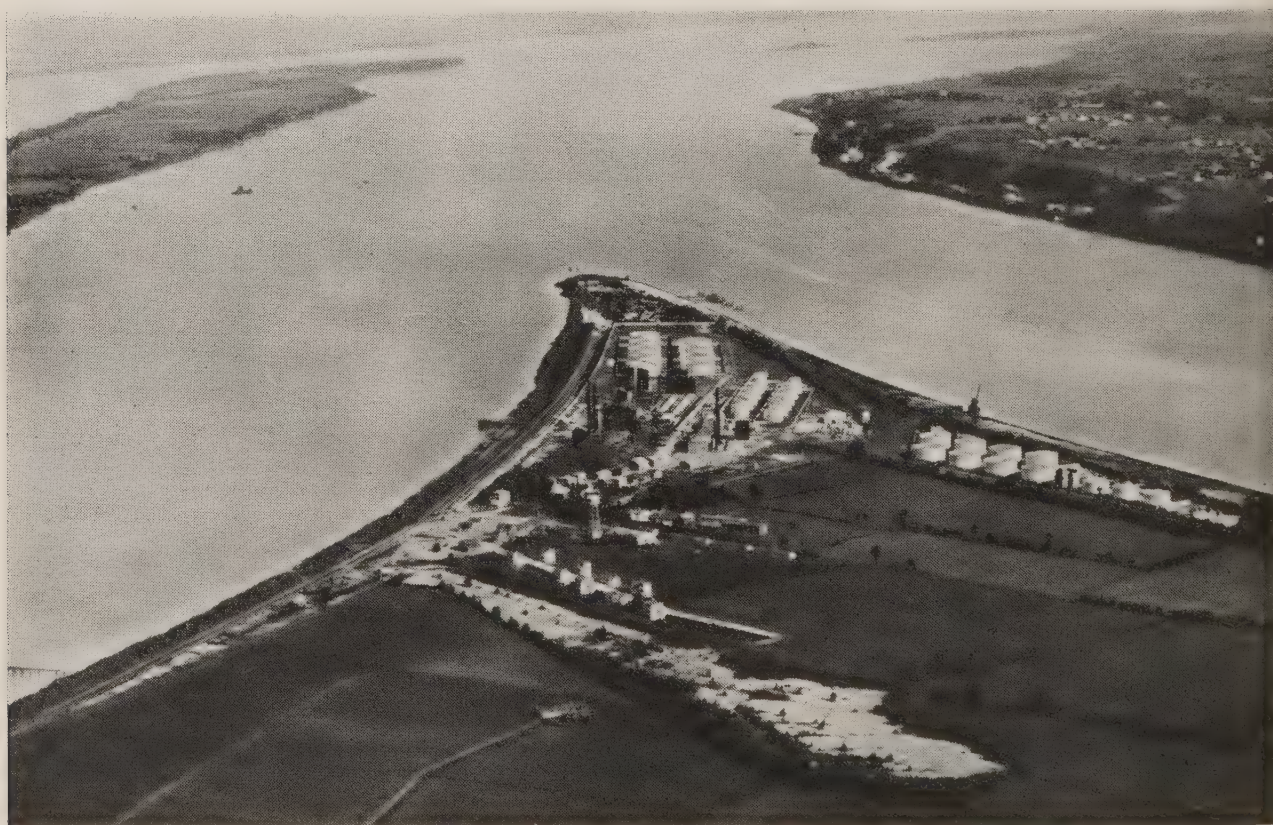


Plate 36. Bec d'Ambes: the refinery (looking north-west, downstream)

The refinery stands at the confluence of the Garonne, on the left, and the Dordogne, on the right. The tanker wharf is near the extremity of the peninsula, on the Dordogne side. (For map see p. 143.)



## BORDEAUX AND THE GIRONDE PORTS

(See Figs. 33, 34, 35, 36, 37; Plates 34, 35, 36, 37, 38)

### *General Description*

Bordeaux is the fourth largest port in France and also the fourth largest city; its population in 1936 was 258,000, while that of the entire urban area was 450,000. It lies 98 km. from the open sea and is the metropolis of the south-west. Like Nantes, it has seen some of its trade pass to new ports lower down the estuary, and has to deal with serious problems of access through the increase in size of ships. The downstream ports are all within the jurisdiction of Bordeaux. They are situated at points where the deepwater channel, swinging from side to side of the estuary, comes close to the shore.

As a port Bordeaux is larger than would be expected considering its distance from the main centres of population in France, and the absence of any industrial hinterland. It is, however, well placed for trade with the Americas, and has benefited from its place as head of the mail service to South America. The recent extensive developments in Morocco have been reflected in an expansion of services from Bordeaux, for the port is conveniently located for serving Casablanca. It is similarly well fitted to serve the French West African colonies. There is not much scope for attempts to divert trade from eastern France and beyond, although during the war of 1914-18 Switzerland used Bordeaux as an outlet. In recent years the industrial possibilities of Bordeaux have improved. It is a suitable site for industries moved from the north-east, having both good port accommodation and a considerable labour supply. Further, it is now within reach of the hydro-electricity of the Pyrenees and Central Massif. The 15,000-volt transmission line follows the Midi railway to the western Pyrenees, and other lines tap the western stations of the Central Massif at Tuillères.

The seaward entrance to the Gironde estuary is constricted by the Pointe-de-Grave, which is subject to an eastward travel owing to erosion on the seaward side and deposition on the landward side. It has been necessary to construct defence works against marine erosion from Pointe-de-Grave to Soulac. At each tidal flow, 1,800 million cu.m. of water are introduced into the estuary, and much of the silt brought by this enormous body of water is deposited on its floor. These deposits can be seen in the marshes of the left bank which form a marked contrast to the calcareous cliffs of the facing



shore. Clay and sand, deposited on the floor of the estuary, eventually cement together forming shoals. A constant addition of alluvium is made by the rivers which drain the basin. Thus the estuary is encumbered by sandbanks, and elaborate investigation of the bank movements is necessary.

In recent years, however, the most serious problems have arisen from the movements of the bar which lies immediately outside the entrance. This bar is primarily the work of the sea, but it is modified

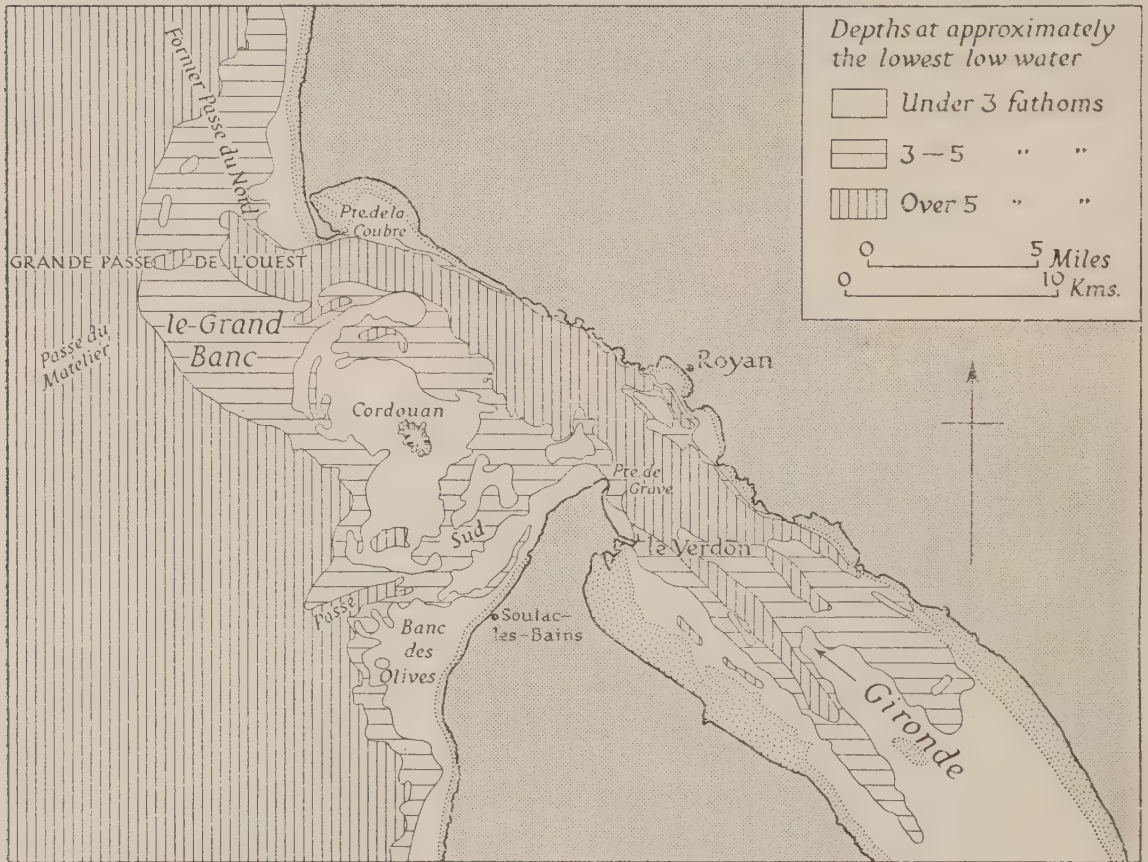


Fig. 33. The Gironde Entrance: Grande Passe de l'Ouest

by the river currents. It is crescentic in plan; the front, which is attacked by the waves, is composed of gravel and pebbles, while the inner side is composed of fine grey sand. There are at the present time two main entries—the Grande Passe de l'Ouest and the Passe du Sud. The former was created in 1930–1 and is the only one capable of taking large ships. Owing to its orientation, this passage is not open to swell. It is 9 km. long and 1,000 m. wide, with a least depth below chart zero of 9.1 m. (30 ft.), increasing to 11 m. (36 ft.) in places; eventually the 11 m. depth will be made general. The Passe du Sud runs along the coast of Médoc and is used only by coastal

and fishing craft, as its least depth is no more than 2·7 m. (9 ft.). The Passe du Matelier, running from south-west to north-east, is now disused and unmarked.

The channels are subject to considerable changes in the course of time. Formerly, the main channel was the Passe des Charentais (Passe du Nord) lying to the north; this channel had been in use for more than a century, but the movement of the Grand Banc caused it to become more sinuous, to approach dangerously close to Pointe de la Coubre, and to become progressively shallower—from 1926 to 1928 the depths decreased from 9 to 6·5 m. (29·5–21·3 ft.). When it became clear that the channel was being closed, the port authorities resolved to abandon this pass and to create a new permanent entry, maintaining the Passe du Matelier while the work was in progress. After prolonged investigations beginning in 1926, the new channel through the bar was opened by the suction dredger *Pierre Lefort*. It proved so successful that the depth when the operations concluded at the end of 1932 has since remained practically constant and maintenance dredging has been unnecessary.

In the river the channel is at least 150 m. wide; the least depth between Le Verdon and Pauillac is 4·4 m. (14·5 ft.), and thence to Bordeaux 4·0 m. (13 ft.). To maintain this channel 1·5 million cu.m. of silt have to be dredged each year. The sandy bottom makes serious damage less likely if ships ground. Tides are felt for 55 km. above the city, and in early days assisted the upstream passage of ships. At Bordeaux the tidal current approaches 2 or 3 knots normally and 4½ knots in flood; at Pauillac the fastest current is 5 knots along a rocky under-sea cliff; near the mouth the speed decreases to 3 knots. Ships drawing 8 m. (26·25 ft.) can reach Bordeaux at high water, and vessels drawing less than 2·3 m. (7·5 ft.) can descend in one tide without stopping at Le Verdon or Pauillac.

### *The Estuary Ports*

*Le Verdon.* The outport of Le Verdon, 3 km. from the sea on the left bank, was put into service in 1933. Access is governed by the depth of the Grande Passe de l'Ouest. There is a berth 317 m. long and with a low-water depth of 13 m. (42·6 ft.) on the river side and another 317 m. berth on the land side with a depth of 10 m. (32·8 ft.). A turning area with a radius of 1 km. has a low-water depth of 10 m. The pier is 38 m. wide and is equipped with four 5-ton electric cranes. It is connected with the shore by an approach viaduct 383 m. long carrying an electric railway which leads to Bor-



deaux. In 1935, 195,000 tons of shipping used the port, carrying 9,400 passengers and 4,400 tons of merchandise. The plans for this outport were approved as long ago as 1910, when there was strenuous competition among neighbouring ports for the South American trade. To attract the fast liners it was necessary to eliminate the journey up the Gironde in order to save some hours' steaming. The war of 1914-18 delayed this scheme but at the same time manifested the need for well-equipped ports far from the war zone. The mercantile

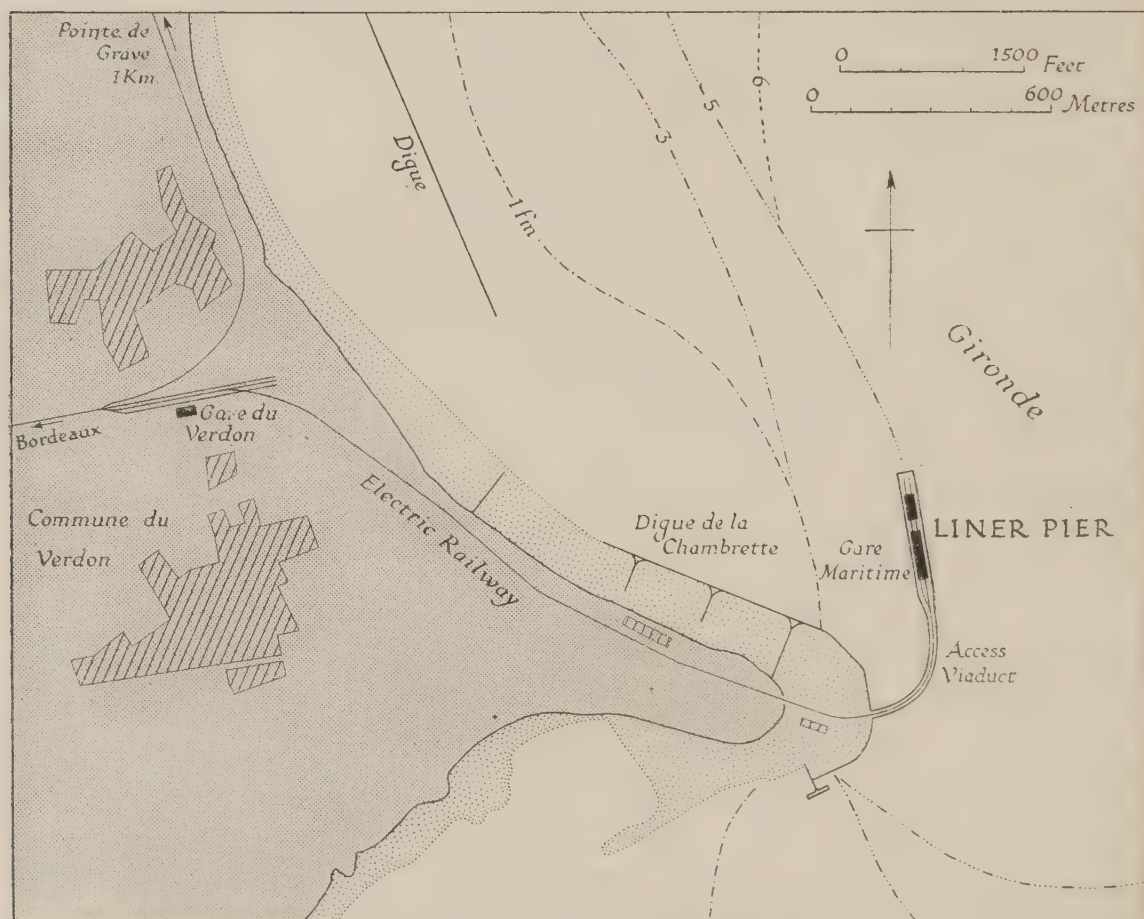


Fig. 34. Le Verdon. (See also Plate 34)

interests of Bordeaux were not united in support of the project, for some feared that the older port would lose trade and that only the railway companies would benefit.

*Mortagne-sur-Gironde.* Some 30 km. farther up the estuary on the right bank lies the little port of Mortagne-sur-Gironde, with an import of coal and export of pit wood; its quays have a depth of 4.4-3.6 m. (14.5-11.8 ft.), and can accommodate vessels up to 1,000 tons. A cement works is situated here.

The principal ports of the upper estuary are *Pauillac*, *Blaye*, and

*Bec d'Ambes.* Details of access and accommodation at these ports are as follows:

	Access				Accommodation			
	Max. draught of ships permitted					No. of berths	Draught permitted	
	H.W.L.N.		M.H.W.S.				m.	ft.
	m.	ft.	m.	ft.				
Pauillac	8·5	28·0	9·25	30·2	Wharf, 710 m.	3 berths riverwards 3 berths shorewards	8·5-9·0 7·0-7·5	28·0-29·5 23·0-24·5
Blaye	7·5	24·5	9·5	31·2	Wharf, 250 m.	2 berths	7·0	23·0
Bec d'Ambes	8·5	28·0	9·5	31·2	Wharf	1 tanker berth	8·5	28·0

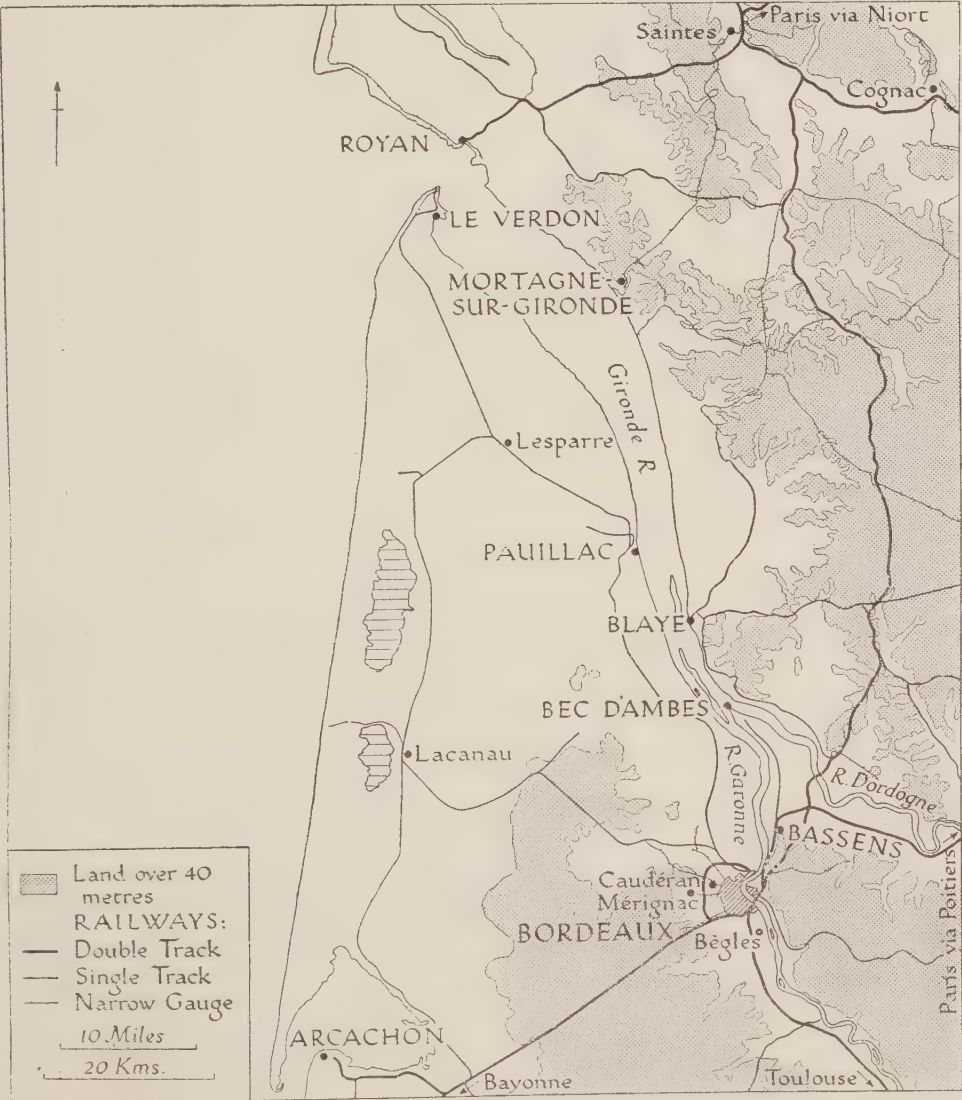


Fig. 35. Bordeaux and the Gironde ports



*Pauillac*, on the left bank and 50 km. from the sea, is the centre of the Médoc wine industry, but owes much of its importance to the Trompeloup roads, where the channel swings in towards the bank. Despite the swift current, Trompeloup has a good anchorage with 7·3–9·7 m. (24–31·8 ft.) of water. Pauillac was for some years the principal outport of Bordeaux, but it has lost trade in the last quarter of a century owing to the improvement of the channel leading to Bordeaux and to the growth of Le Verdon. It has developed, however, a considerable petroleum trade; two companies have oil berths there, and one has a refinery with an annual capacity of 600,000 tons (see Plate 35).

*Blaye*, 63 km. from the sea, lies on the right bank of the estuary; it can accommodate vessels up to 7,500 tons. The trade consists of petroleum, coal and pit wood, and many vessels outward bound from Bordeaux call here to complete their cargoes and to take aboard provisions.

*Bec d'Ambes* lies 11 km. farther upstream at the apex of the Garonne-Dordogne confluence. It is an important petroleum discharging point at which there is a refinery with an annual capacity of 500,000 tons (see Plate 36).

*Furt* and *Trabuchet* are minor ports.

### *Bordeaux—Detailed Description*

The maritime port of Bordeaux proper extends for 13 km. downstream from the Pont de Pierre and includes Bassens on the right bank and Grattequina on the left bank. Access is possible at H.W.L.N. for vessels drawing 8·25 m. (27·2 ft.) and at M.H.W.S. for vessels drawing 8·75 m. (29·7 ft.). Besides the extensive river quays, there are two wet docks, with an area of 16 ha. These basins are entered by two parallel locks which are 152 m. (498·6 ft.) long and 22 m. (77·2 ft.) wide, and 132 m. (433·2 ft.) long and 14 m. (45·9 ft.) wide respectively, and in which the sills are 3 m. (10 ft.) below datum. The two docks are connected by a gate 25 m. (82 ft.) wide. The maximum length and beam permitted are 143 and 21 m. (469 and 69 ft.).

In addition, the 300 m. Douanes quay at Bordeaux is undergoing reconstruction. It has been necessary to reconstruct some of the quays owing to the insecurity of their foundations in a weak subsoil and because their surface was too low in time of floods.

Generally speaking, the passenger and cargo liners use the river quays in the city (see Plate 38); coal, timber and other heavy goods



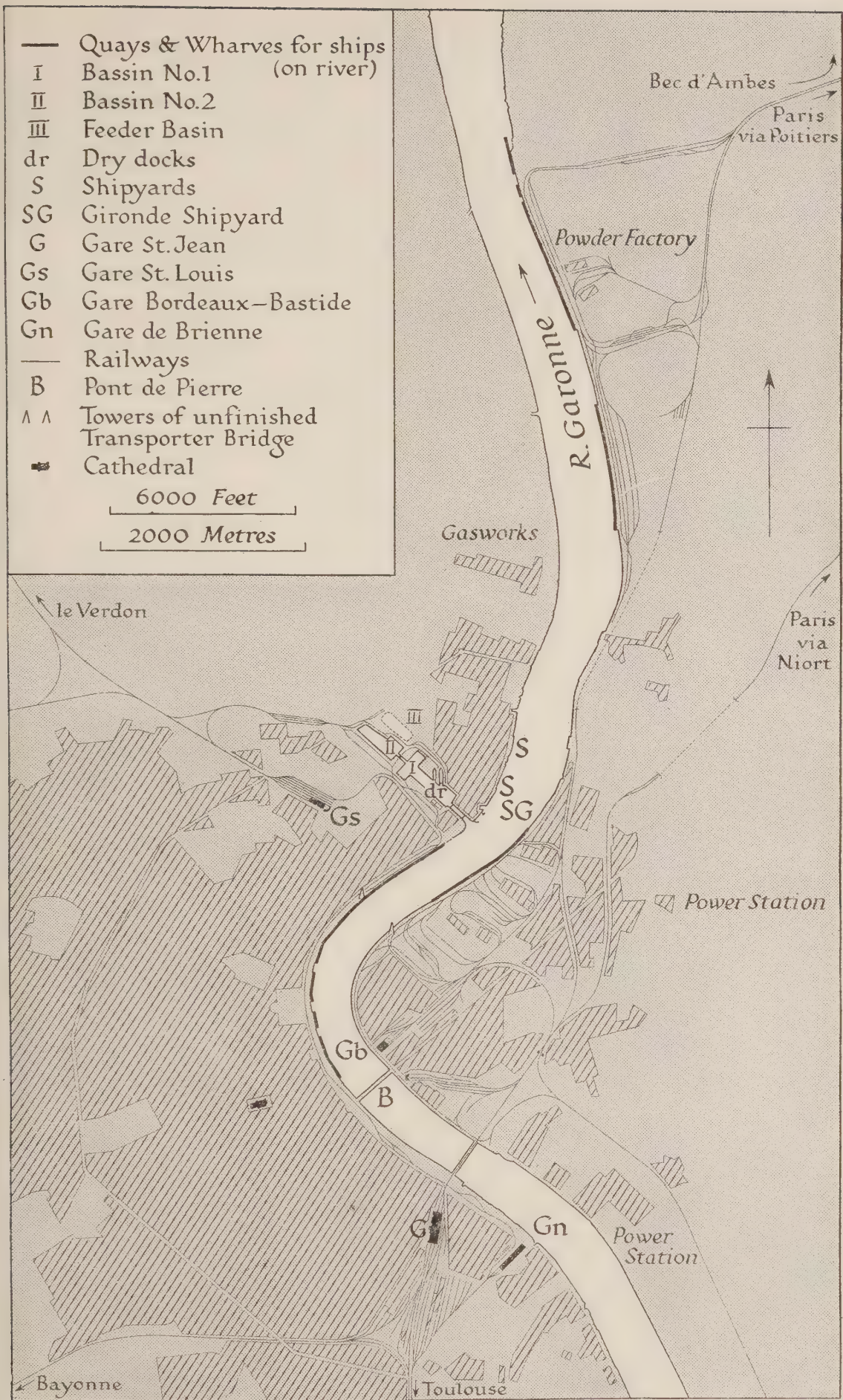


Fig. 36. Bordeaux

The position of the recently constructed Floirac power station is indicated by the words 'Power Station' in the south-east of the map; the large block of buildings immediately to the north are aircraft component works. The power station to the east of Bordeaux is a small plant. Since the German occupation a great deal of activity has been going on adjoining and to the north of the feeder basin.



are handled in the docks and at the lower quays. Half the coal imports go to the right bank, and a quarter to the docks. The tonnage of cargo handled is about equally divided between the two banks. Although Bordeaux and most of the suburbs lie on the left bank, more cargo is discharged on the right bank. The importance of the timber export is shown by the fact that of the tonnage of cargo loaded, over 80 % is provided by the left-bank quays and docks.

### *Accommodation*

	Max. draught possible		No. of berths
	m.	ft.	
Quays: Left bank quays	8.0-9.0	26.25-29.5	20
Queyries wharves	7.0-8.0	23.0-26.25	12
Bassens quays	7.0-8.0	23.0-26.25	20
Docks: No. 1	6.5	21.3	28
No. 2	6.0	19.7	10
			7,225 m. of quays
			2,550 m. of quays

In most years the use of the berthage in Bordeaux and the estuary ports was as follows:

Nature of traffic	No. of berths	Length m.
Coal and other goods in bulk	20	2,265
Petroleum and petroleum products	6	820
Pit-props	8	695
Colonial woods	2	250
Cereals in bulk	3	325
Cereals in sacks	2	250
Refrigerated provisions	1	120
Regular passenger and cargo liners	22	3,130
Various	40	4,145
Total	104	12,000

### *Port Facilities*

The crane equipment is considerable, comprising 177 cranes under 10 tons capacity, of which 158 are electric; six floating cranes (with a maximum capacity of 300 tons), forty-six other lifting appliances for coal, timber, fruit and grain cargoes, and a fixed crane of 250 tons capacity. There are two dry docks at Bordeaux, the larger of which has a useful length of 157.1 m. (515 ft.) and a depth on the sill of 7.5 m. (24.6 ft.).

*Pauillac* is equipped with a fairly complete repairing centre, including a floating dock of 8,000 tons capacity, with a useful length of 155 m. (508 ft.) and capable of taking vessels with a draught of

8.5 m. (27.8 ft.). There are also a floating workshop and a shore workshop.

### *History*

The site of Bordeaux is extremely low, covering slight undulations of the ground which nowhere attain more than 20 m. altitude. For its size it is the least crowded of all French cities; it covers an area of 3,700 ha., while Paris itself occupies only 7,800 ha. The original settlement was made on the left bank of the Garonne, where firm ground lies close to the deeper water on the outside of a semi-circular bend. The city has grown in concentric semi-circles around this point, and there has been only a moderate expansion of the suburbs on the opposite bank, while the satellite towns, like Bègles and Caudéran, are all on the Bordeaux side of the river.

Bordeaux has always been the commercial metropolis for southwestern France, even from Roman times. Before the age of the steamship it enjoyed two periods of great prosperity. The first was during the 300 years from 1154 to 1453, when it was the capital of the English possessions of Gascony and Guyenne. During this period the wine trade developed to great proportions and passed mainly through the city. After the unsettled history of the next two centuries came the second period of prosperity, when, like Nantes, it developed an active trade in plantation products from the French colonies. From 1717 to 1788, for example, the value of its trade multiplied by twenty times, and it had 300 ships up to a tonnage of 600 engaged. The Napoleonic wars inevitably caused a sharp reduction in trade. Shortly after, in 1821, the completion of the famous Pont de Pierre carrying the Route Nationale to the Spanish frontier set an upper limit to the maritime port. In the nineteenth century the growth of trade was not rapid; from 1827 to 1877 the tonnage of ships using the port increased from 0.25 million tons to 1.4 millions. The provision of modern port facilities began in 1856 with the construction of the first vertical quay, 700 m. long; soon after, in 1869, the first dock basin followed. From 1877 to 1913 the tonnage of shipping increased from 1.4 to 4.6 millions, an expansion which was reflected in further dock improvements. The increasing size of ships necessitated the establishment of the first outport in 1894, at Pauillac-Trompeloup; 1911 saw the completion of the second basin in the city. During the war of 1914-18 the remoteness of Bordeaux from the eastern frontier stimulated trade, and tonnage in 1918 amounted to 6.9 millions. It was one of the principal disembarkation points for



the American Expeditionary Force, and the Gironde estuary resembled an immense roadstead with shipping of every size moored in long lines. This activity was reflected in the scheme for a considerable extension at Grattequina, a little below Bordeaux, to form a new series of docks, but the project has remained unrealized. Since 1918 the amount of traffic fluctuated about a downward trend, to reach 3.3 million tons in 1937. In contemporary history Bordeaux secured a momentary fame as the last seat of government in independent France, a function it had acquired in 1870 and in 1914, when the government moved there owing to the imminent danger to the capital.

### Trade

#### *Cargo Movements, 1937 (thousands of tons)*

	Foreign trade		Foreign total	Coastwise total	Sea-borne total
	Discharged	Loaded			
Bordeaux	2,526.1	799.8	3,325.9	749.7	4,075.6
Mortagne	12.0	0.2	12.2	37.3	49.5
Paullac-Trompeloup	492.1	120.4	612.5	317.4	929.9
Blaye	89.5	45.3	134.8	85.3	220.1
Furt	2.3	—	2.3	46.9	49.2
Bec d'Ambes	338.9	53.0	391.9	207.4	599.3
Totals	3,460.9	1,018.7	4,479.6	1,444.0	5,923.6

Total foreign trade of Bordeaux and estuary ports, 1938 (provisional figures): 4,144.1.

As with most French ports, fuels form the bulk of the imports; the only important raw material to counterbalance the inward movement is timber, and the disproportion is thus very high, the fuel import amounting to two-thirds of the total. Owing to the poverty in fuel of south-western France, Bordeaux has imported coal since the seventeenth century.

In 1913 1.78 million tons were imported, i.e. 54 % of the imports by weight; the figure rose to 1.83 million tons in 1918, and owing to the breakdown of German railways after the war, to a peak of 1.95 millions in 1924. Since then the tonnage has fallen to the 1 million tons of 1938, 37 % of the imports by weight. As a coal port Bordeaux is second only to Rouen. Small quantities of coal are provided by Germany, Poland, and Belgium, but the bulk is provided by Great Britain. Pit-props from the Landes or Spanish iron ore furnish a return cargo to South Wales. Formerly the Midi and Orléans railways

took 56 % of the coal import, but their share fell to 34 % in 1930 owing to the electrification of the Midi, and to the fact that more P.O. railway coal passed through Nantes or Paris. The petroleum imports follow coal very closely, and have expanded much more rapidly than coal as a bulk import.

Pauillac receives the largest share of the petroleum imports, and is followed closely by Bec d'Ambes. After a disastrous shipping fire in 1871, the unloading of petroleum or its products has been forbidden in Bordeaux itself. The main suppliers are U.S.A. and Venezuela.

Minerals and crude chemicals provide a big total: sulphur from Louisiana and Texas, phosphates from North Africa, natural nitrates from Chile, synthetic nitrates from U.S.A., Germany, Great Britain and Norway, copper sulphate and pyrites. Many of these chemicals are used in the vineyards, and others are the basis of chemical industries. Up to 1931 phosphate imports exceeded 100,000 tons, but the quantity has since dropped below 70,000; North Africa has totally replaced the U.S.A. as a source of supply.

Of the imports of foodstuffs wheat fluctuates in quantity according to the state of the harvest; the rice import is more steady. Colonial imports survive from the eighteenth century, and consist chiefly of sugar. The port has been successful in its endeavour to become a centre of the sugar trade; Cuba and the French islands of Martinique and Guadeloupe supply the bulk of the import. Other foodstuffs include fruit, wines, and spirits, and various forms of preserved fish; cod are dried in the district, and in this activity Bordeaux is second only to Fécamp. A considerable amount of the banana consumption of Paris enters via Bordeaux, with 86 % coming from the Canaries, and the rest from Jamaica. Oil seeds now form an important item; ground-nuts are the largest single type. They were first imported for oil about 1850; the bulk comes from Senegal, with smaller supplies from Nigeria. The comparative smallness of the imports of textile raw materials and of metals is an indication of the distance of Bordeaux from any great centre of industry. Wool and skins imported from the Argentine and North Africa are sent to Mazamet. Little cotton is imported, but the amount is increasing, whereas the amount of jute is on the decline. About 5,000 tons of rubber and natural gums are imported from French West Africa; Bordeaux made efforts to become the French centre for rubber imports, but Marseilles is more conveniently situated for the Far East supplies. Softwood timber, pulp and paper imports are not above the normal



quantities for a port which is a considerable centre of population. Tropical hardwoods are supplied by French West Africa, and a wood storage centre at Bassens is stimulating this trade.

The exports of Bordeaux are dominated by the pit-props from the Landes, where the annual production reaches 0·75 million cu.m. of props; they provide nearly half the weight of exports. From the peak year of 1923 exports fell to a low level in 1926 owing to the British coal strike, and this decline has continued with the depression in the British coal trade, especially in Wales. About four-fifths of the timber is loaded at Bordeaux, and the rest at Blaye and Pauillac. In 1937 4,000 tons of railway sleepers were exported; other exports include forest products such as gums and resins. Wine is second to pit-props in weight. After the phylloxera disease had been overcome the vineyards were re-established, but meantime competition had developed from other countries, and the trade never recovered; the export, which in 1913 amounted to 100,000 tons, now reaches only 40,000 tons. The Gironde wines provide one-third of this amount. Five other groups of commodities each furnish about 40,000 tons of the remaining weight of exports—metals, chemicals, petroleum products, foodstuffs, principally sugar, and manufactures. The manufactures are very varied, with paper, dyes and metal goods and machinery outstanding; though small in bulk, their value is high. The comparatively small weight of industrial products reflects the non-industrial nature of the hinterland.

The passenger traffic is principally with Morocco, and its amount equals the traffic with the next two important destinations—West Africa and Great Britain. The statistics for 1935 are given below:

	Disembarkations	Embarkations
Antilles, Central and North America and Pacific	59	1,916
South America, Atlantic coast	1,939	1,494
West Africa	5,532	7,511
Morocco	10,881	11,116
Great Britain, etc.	5,025	5,332
Foreign navigation	23,436	27,369
Coastal navigation	10,061	10,035
Total	33,497	37,404

Altogether, fifty passenger and cargo lines make Bordeaux a port of call.

## Industries

The industries of Bordeaux are considerable in the aggregate, and go far to account for the population of 450,000 in the city and adjoining satellite towns. Two groups of important industries are local

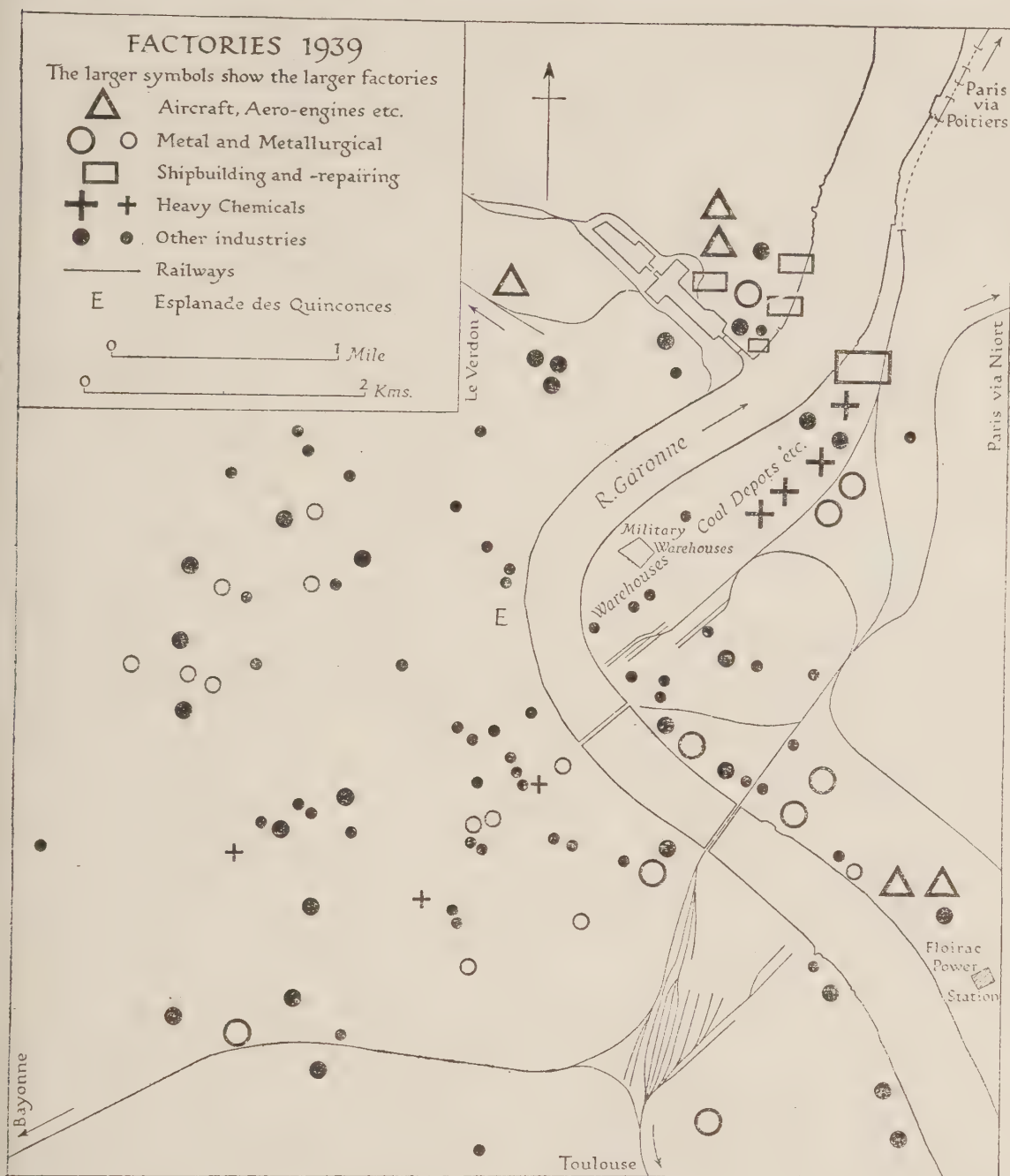


Fig. 37. The industries of Bordeaux

Most of the factories in Bordeaux itself, apart from the shipbuilding and aircraft downstream, are of the type usually found in a large city, or deal with products of the neighbourhood or of the French colonies—fruit preserving, chocolate and tobacco manufacturing, sugar refining, and distilling. The heavy industries are concentrated downstream and on the right bank, where there is more ground available. On the right bank, apart from those factories which are specified, lie most of the public works contractors' yards.



in character: the preserving of fruit, distilling of spirits, etc., are based upon the agricultural products of the south-west, and the manufacture of chemicals is largely for the rural market. The largest item is superphosphates, for which Bordeaux is the fifth largest centre in France, having an annual production of about 120,000 tons. Another group includes the industries dependent upon imported tropical raw materials, the principal being oil-seed treatment and vegetable-oil refining, with associated chemical and soap manufacture, and sugar refining. The import of fuels gives rise to industry in briquette manufacture at Bordeaux and petrol refining at the estuary ports of Pauillac and Bec d'Ambes. A rapidly expanding industry of recent date is the manufacture of cement; Bordeaux is now one of the principal centres of the industry in France. The three factories, which use lime from St Astier near Périgueux, are at Lormont. An important group of industries consists of shipbuilding and allied engineering, more extensive than might be expected. There are three shipbuilding yards: *Forges et Chantiers de la Gironde*, with four large slips, up to 213 m. (700 ft.), *Ateliers et Chantiers Maritimes du Sud-Ouest*, with four stone slipways, up to 149 m. (490 ft.), and engine boiler shops nearby, and *Chantiers et Ateliers Dyle et Bacalan*, with four slips, up to 120 m. (393 ft.), and a large engineering works. The Bacalan shipyards have constructed vessels up to 10,000 tons. A large engineering works, with foundries, is situated at Lormont and there are various small undertakings. Industries sponsored by the government have been encouraged to some extent by the favourable strategic location of Bordeaux; there are four government chemical and explosive factories. Considerable aircraft works include a nationalized aeroplane plant, an engine factory, and a factory manufacturing engine parts.

### *Communications*

There are 176 km. of railways in the port. It is served both by the Western and South-Western regions of the S.N.C.F. From Bordeaux electrified main lines run northwards to Tours and Paris and southwards to the Spanish frontier, while a branch serves the liner mole at Le Verdon. Steam-operated lines provide an alternative route to Paris via Niort and Saumur, and a direct route to Toulouse and the Mediterranean. A local line to the Médoc district begins in the city. The station movements in 1935 were:

Removals	829,000 tons	27·5 % of the imports through the port
Arrivals	457,500 tons	42·4 % of the exports through the port





Plate 37. Bordeaux (looking north, downstream)

In the foreground is the church of St Michel and the Pont de Pierre. Below the bridge the quays of the port line the river around the first bend. The towers of the long uncompleted Transporter Bridge can be seen. On the right bank is the heavy industry quarter, with coal depots, chemical factories, etc. The large white building on the right bank is the important flour mill of the *Grands Moulins de Bordeaux*. (For map see p. 145.)





Plate 38. Bordeaux: Quai des Quinconces (looking south, upstream)

The liner *Massilia* (15,000 tons gross), engaged in the South American service of the *Cie Sud-Atlantique*, is seen alongside. In the background is the Pont de Pierre, the upper limit of maritime navigation, and the church of St Michel. (For map see p. 145.)



Plate 39. Bayonne: entrance to the Adour estuary. (For map see p. 154.)



River navigation, involving over 1 million tons annually, is most active below Bordeaux, with inward and outward movements roughly equal. The Canal du Midi connects Bordeaux with the Mediterranean, but has never been very important; it carries only 15 % of the inland navigation traffic. There is no canal connexion with the Seine basin network. The rivers are far from ideal transport agencies, for they are subject to both floods and periods of low water which hinder navigation.

## BAYONNE

(See Fig. 38; Plates 39, 40)

### *General Description*

Bayonne (pop. 31,000) is the only fully equipped French port south of the Gironde. It lies 5 km. from the sea, where the Adour is joined by the Nive tributary. The greater part of the town, containing the old castle and the cathedral, is situated on the left bank of the Nive and Adour, but part lies between the two rivers, and contains the new castle (see Plate 40).

The approach is over the Barre shoal with a depth of 3·4 m. (11 ft.) in 1931, but is continually changing its depth and position. Two breakwaters lie on either side of the entrance (see Plate 39). The river itself is suitable only for temporary anchorage; in strong westerly weather a heavy swell is felt, and at spring tides there is a violent stream. Navigation in the river has to take account of a shoal, a mud-flat and a rock.

### *Detailed Description*

The port can receive vessels of 104–9 m. (341 ft.) in length, the draught depending on the depth on the bar; in ordinary weather vessels with a draught of 6·4 m. (21 ft.) can enter at neap tides, vessels of 7·3 m. (24 ft.) draught at springs. Regular dredging provides a depth of 6·5–8·5 m. (21·3–28·0 ft.) in the fixed channel, but after the winter gales, when dredging is most restricted, the depth decreases. The port consists of two sections: Le Boucau, the part of estuary below St Bernard Bank, and Bayonne itself, as far as the bridges at the confluence of the Adour and Nive. The total length of quays and wharves, for both maritime and river traffic, is 4,460 m., of which 1,100 m. are privately owned. Only 2,400 m. of this length



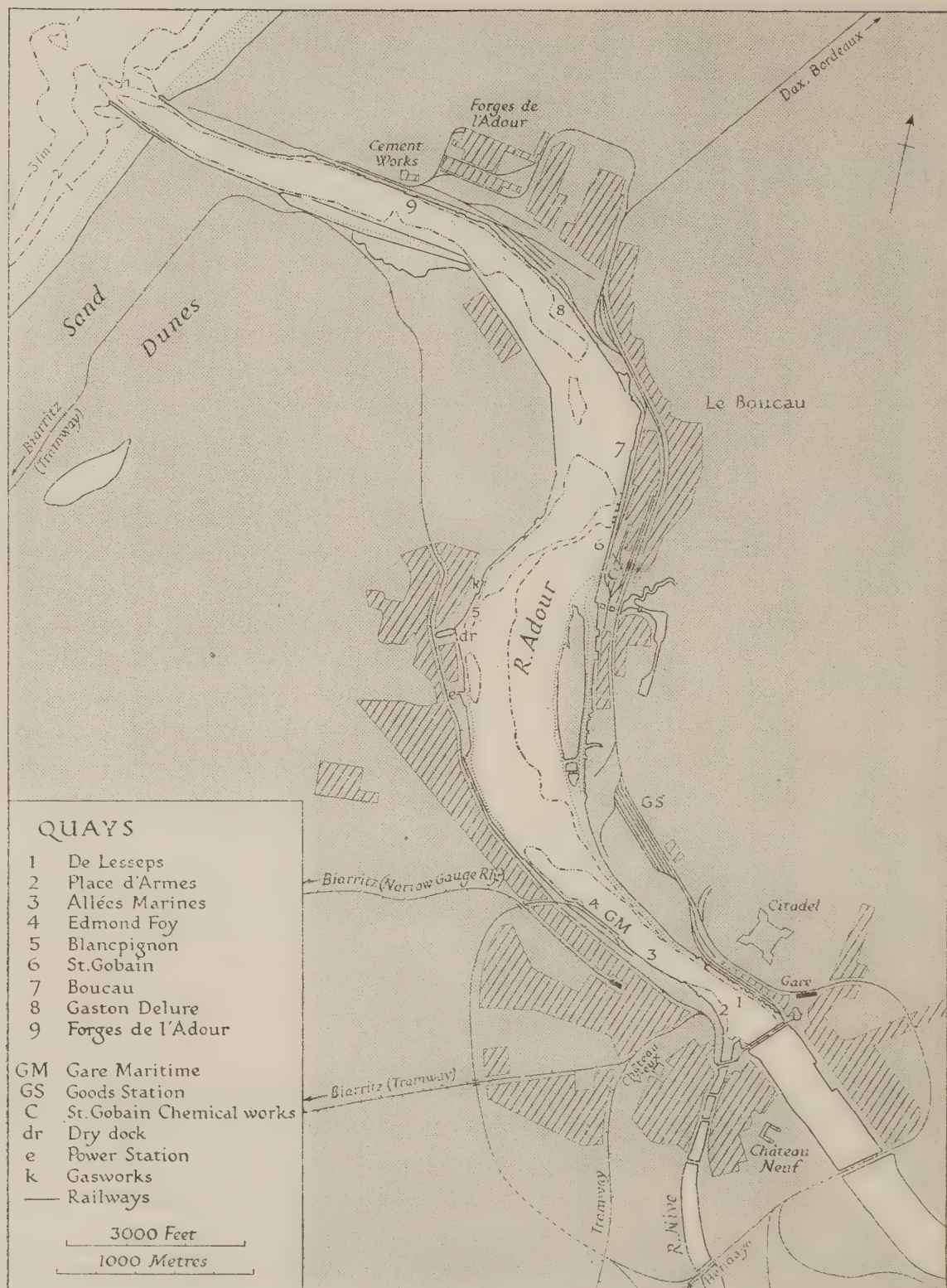


Fig. 38. Bayonne

is normally used by sea-going vessels, representing twenty-nine berths. The berths admit vessels of the following draughts:

		m.	ft.
14 berths	Less than	5.5	18
8 „	„	5.5-6.5	18-21.3
3 „		6.5	21.3
4 „		7.0	23

Eight of these berths are not equipped with cargo-handling gear. The Allées Marines quay, 300 m. in length, which admits vessels drawing over 7.0 m. (23 ft.), is a vertical quay; the remainder of the berths are alongside wooden wharves, built in front of old masonry quays so as to avoid the stony slopes from the foot of the old quays down to the river bed. While most quays handle coal imports, the quays of Le Boucau deal with the bulk of the imports of phosphates, ore, and pyrites, and with the export of pit-props; miscellaneous traffic is dealt with at Bayonne itself, and the de Lesseps quay receives large vessels which discharge wheat for local mills. Three private installations receive petroleum products, tar, bitumen, etc. In some years the Forges de l'Adour quay handles over one-third of the total trade and Edmond Foy quay over one-quarter. The highest rate of discharge of bulk cargo obtains at the Edmond Foy quay, reaching 2,400 tons a day. Covered storage accommodation amounts to only 5,800 sq.m., as most of the trade is in heavy commodities like coal and minerals which can stand exposure to the weather, and for which 7 ha. of storage grounds are available.

### *Port Facilities*

There are forty-three cranes under 10 tons capacity, a 30-ton fixed crane, and a 14-ton transporter.

Repairs to machinery can be carried out, and the dry dock at Blancpignon can accommodate most vessels which can enter the port; it is 98 m. (321.5 ft.) long. There is a 650 h.p. tug available, and diving apparatus.

### *History*

In the thirteenth century, under the English rule of south-western France, the port of Bayonne prospered as a centre of the wine trade. Later on the shifting of the river outlet, owing to storms and bank movements, presented serious problems, and in 1599 a new deep and direct entry, the Boucau Neuf, was constructed. The Adour formerly flowed into the sea on the north side of Cap Breton; by



a dam at Le Boucau its course was deflected to the west. Later came new southward movements of the channel, making it sinuous and dangerous. Since then, the mouth has been the vital problem of the port. The Bayonne Chamber of Commerce, established in 1726, attempted to fix the channel after 1750 by means of solid jetties, 'pleines longitudinales', extending progressively to the south, in which direction the mouth was tending to move. Originally 275 m. apart, the interval has been reduced to 200 m. and the channel displacements arrested. Under the Second Empire, the movement of goods, largely owing to the imports, amounted to more than 100,000 tons a year, and Napoleon III ordered new studies to improve the port in view of the value of its trade. The traffic arising from the Basque whalers and Newfoundland cod fisheries declined, but in 1859 came the beginning of shipments of an important modern article of trade—pit-props from the Landes. A minor but long-standing export is salt.

Towards the end of the century the jetties were prolonged so as to obtain deepening without an advance of the beach. The establishment at Boucau, in 1882, of the *Forges de l'Adour*, a subsidiary of the *Aciéries de la Marine et d'Homécourt*, resulted in a great increase of tonnage and an urgent need for improvements of the entrance. So in 1895 a new programme was adopted of further jetty construction, together with the use of dredgers, and since then dredging has been progressive. The two dredgers of 400 cu.m. capacity now employed have succeeded in fixing the channel. 1892 saw the construction of a refitting basin; during 1906–13 the Casquets and Blancpignon channels were deepened, and during 1932–3 rocks of the Casquets platform were removed. In 1930 work was commenced on the improvement of the right bank, the lengthening of the Edmond Foy quay, the extension of the Allées Marines station and the provision of further sidings to hold 200 wagons.

### Trade

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	567.9
Exports	126.3
Total	694.2
Coastwise trade (total)	69.7
Total sea-borne trade	763.9
Total foreign trade 1938 (provisional figures)	610.5

The cargo tonnage of the port grew from 36,500 tons in 1848 to 417,500 in 1894, and reached a peak with 1,025,000 in 1913. Since then the figures have fallen, particularly the exports; in 1928 the traffic amounted to 743,000 tons, in 1931 to 596,000, in 1937 to 694,000 and in 1938 to 610,000. The depression of 1931 was most felt by the heavy commodities, although there was a great increase in oil imports and in trade with the Pyrenean region, owing to hydro-electricity developments.

The passenger trade has always been negligible, although many yachts use the port.

The hinterland of Bayonne extends as far as the central Pyrenees and even includes the department of Ariège; to the north it covers the department of Landes, meeting the competition of Bordeaux. Southwards, it has not been able to attract the trade of northern Spain, owing to the change in gauge of the railways and to the competition of the Spanish port of Pasajes. So far Bayonne has not succeeded in acting as a port for the middle Garonne valley to any great extent, which is served by Bordeaux and the Mediterranean ports. It lies 270 km. from Toulouse, and 175 km. from Bordeaux.

### *Industries*

Beyond local industries of milling, etc., the chemical works and the iron and steel plant are the most important. The former is engaged principally in the manufacture of phosphates and other materials for agricultural use. The latter produces steel bars, billets, plates, etc., ferro-alloys, and coke-oven bye-products.

In recent years an important addition to the industrial activity of the district has been the establishment of two of the nationalized aircraft factories, one at Bayonne and another at Aire-sur-Adour, 123 km. distant. Both the town and the neighbourhood will probably benefit from its connexion with the hydro-electricity network of the Pyrenees which provides a favourable base for industries requiring plentiful supplies of cheap power. Thus the cargo demands of the hinterland may well increase in the future, although electrification will to some extent diminish the need of coal imports.

### *Communications*

The equinoctial tides reach 56 km. above Dax. The Adour is navigable for small craft to St Sever, which lies at a distance of 134 km. from the sea, and the Nive as far as Ustaritz, 20 km. above Bayonne. River navigation transports the limestone flux for the iron



and steel works and the heavier building materials. The bulk of the port traffic is handled by the railways, however, and the port itself is equipped with 7·6 km. of line. All the lines serving the town are electrified: they run to Biarritz and Hendaye, to Bordeaux via Dax, and to Toulouse via the rather circuitous route through the foothills of the Pyrenees. A further line penetrates the western Pyrenees to reach St Jean-Pied-de-Port.

## MINOR PORTS OF THE ATLANTIC COAST

### *Trade of the Minor Ports of the Atlantic Coast*

	No. of ships	Foreign trade (thousands of tons)				Coasting trade (thousands of tons)		
		Net tonnage	Im- ports	Ex- ports	Total cargo	In- wards	Out- wards	Total
Douarnenez	73	10·6	8·2	1·2	9·4	15·8	4·7	20·5
Audierne	22	2·1	2·7	0·7	3·4	8·5	1·6	10·1
Loctudy	44	6·3	5·9	0·2	6·1	2·9	1·0	3·9
Pont l'Abbé	24	2·5	3·8	—	3·8	5·9	1·8	7·7
Quimper	123	22·3	29·9	0·1	30·0	15·5	2·3	17·8
Concarneau	36	4·5	5·0	2·7	7·7	19·3	10·3	29·6
Quiberon	20	2·8	4·0	3·2	7·2	7·6	1·6	9·2
La Trinité	29	3·7	1·9	2·8	4·7	0·2	0·1	0·3
Vannes	109	18·2	17·2	8·8	25·0	13·5	1·8	15·3
Les Sables d'Olonne	116	60·0	69·8	2·8	72·6	1·3	11·0	12·3
Marans	15	7·4	9·8	—	9·8	1·5	6·5	8·0
Arcachon	28	25·9	29·7	4·5	34·2	—	—	—
Total		166·3			213·9			134·7

Along the Biscayan coast of Brittany there are, as on the Channel coast, a number of small ports, known mainly for their fishing activities. *Douarnenez* (pop. 10,300), *Quimper* (pop. 15,000) and *Vannes* (pop. 18,700) are the largest of these; their coasting trade is as large as their foreign trade. The bay at Douarnenez is used by ocean-going tugs, which wait in readiness for any demands from ships in the Atlantic. *Audierne* (pop. 3,300), *Loctudy* (pop. 1,000), *Pont l'Abbé* (pop. 5,000), *Quiberon* (pop. 1,700), and *La Trinité* (pop. 800) are all very small harbours visited by a few ships from foreign countries each year, and in nearly all the coasting trade is much more important. *Concarneau* (pop. 5,700) is an active fishing port, and a marine biological research station is established there. It is the best known of the Biscayan harbours of Brittany. Its foreign trade is small, and is largely tributary to the fishing

activities. The port is tidal, and while it normally accommodates vessels of several hundred tons, it has received ships up to 3,000 tons gross.

Southwards from Brittany there are fewer small ports, apart from those which engage almost entirely in traffic with the islands off the coast. Half-way between the Loire and La Pallice lies *Les Sables d'Olonne* (pop. 14,000). Vessels of 90 m. (295 ft.) length can enter the basin of this port, which provides a draught of 4.0 m. (13 ft.)

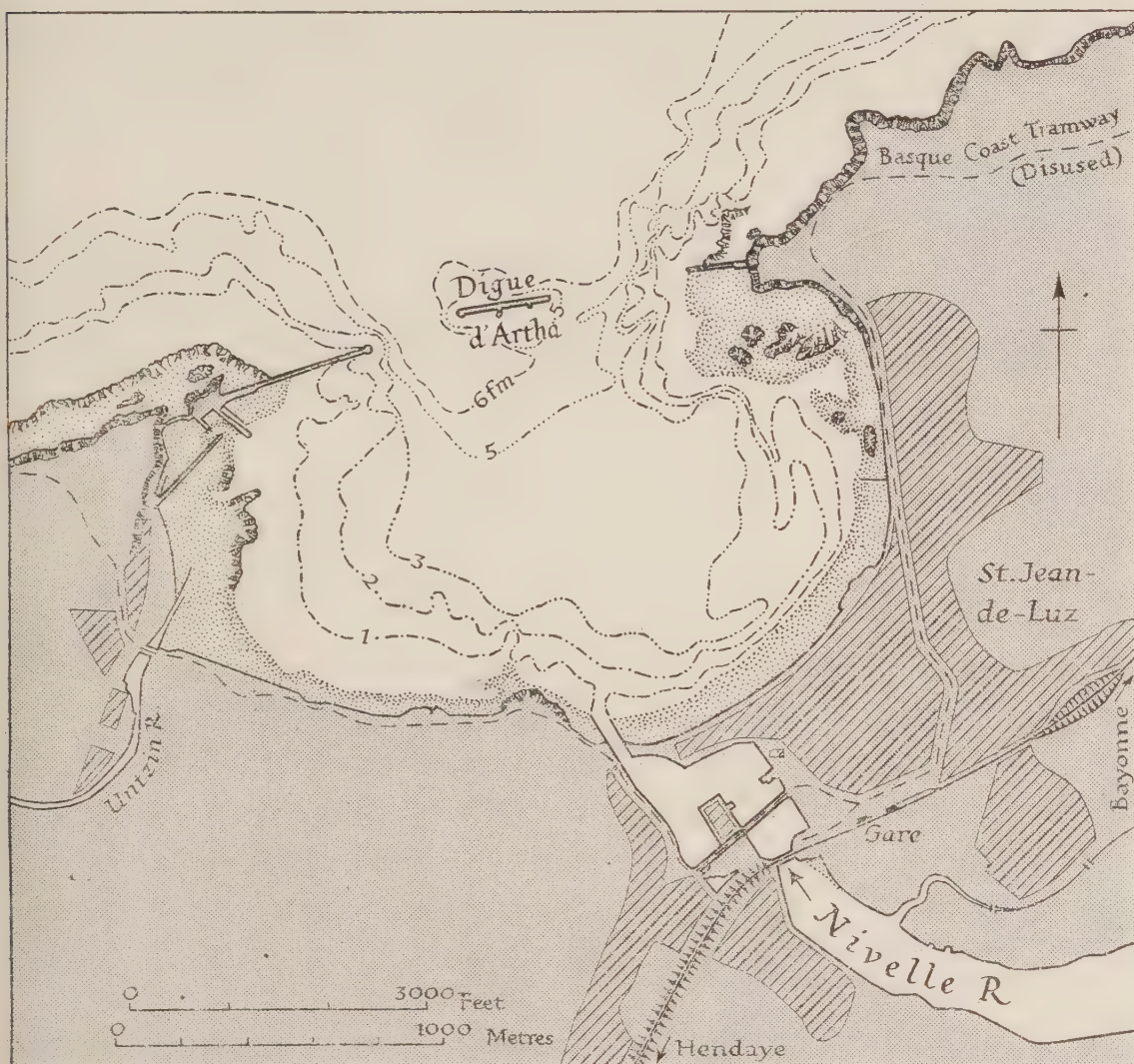


Fig. 39. St Jean-de-Luz. (See p. 160)

at M.H.W.N. and 5.0 m. (16.5 ft.) at M.H.W.S., although at the highest springs the basin will allow draughts up to 5.75 m. (18.7 ft.), and two lightening quays draughts of 7.0 m. (23 ft.) and 6.0 m. (19.7 ft.) respectively. Eight berths are provided at the 842 m. of quays, which are equipped with eight cranes of under 5 tons capacity. To the south-east is the small port of *Marans* (pop. 2,600), 8.5 km. from the sea on the Marans river, and reached partly by the river and partly by a canal. Vessels up to a length of 80 m. (262.5 ft.) can ascend to



Marans on a draught of 4·8 m. (15·7 ft.) at M.H.W.N. and 5·6 m. (18·4 ft.) at M.H.W.S. There is one berth allowing a draught of 5·2 m. (17 ft.), one of 4·7 m. (15·5 ft.) and one of 4·4 m. (14·5 ft.). There are 230 m. of quay for ships drawing over 3·0 (10 ft.), and two 1½-ton steam cranes and one 3-ton electric crane. The traffic using Marans is small in amount, and the coasting trade is as important as the foreign. The only remaining minor port of the Biscayan coast worth noting is *Arcachon* (pop. 12,500), half-way along the straight shoreline of the Landes. The port stands on the large inlet known as the Bassin d'Arcachon, and consists of a number of small piers, the largest of which is 134 m. long, with a depth of 3·0 m. (10 ft.), at its head. Arcachon is much more important as a fishing harbour than as a commercial port.

*St Jean-de-Luz* (pop. 6,700), at the mouth of the estuary of the Nivelle, is a small resort and fishing harbour, 15 km. south-west from Bayonne. The Baie de St Jean-de-Luz is of some importance, for it provides shelter on a coast which is deficient in good harbours. There is anchorage in depths of 6–12 m. (19·7–39·5 ft.). Across the entrance to the bay are three breakwaters: to the east is the Digue de Ste Barbe, 183 m. long, in the centre is the Artha breakwater (250 m.), and to the west is the Digue de Socoa (320 m.). This bay shelters vessels bound for Bayonne which are unable to make the difficult entrance to that port in bad weather, or are waiting for the tide. Pilots for Bayonne can be obtained at St Jean-de-Luz. The port itself is suitable only for fishing boats and other small craft.

Along the Atlantic coast south of the Loire are a number of very small harbours classified as ports in French government returns. They have no foreign trade, but the coastwise traffic of a few of them amounts to 20,000 or 30,000 tons annually, although in most it is smaller. They are *Camaret*, near the entrance to the Rade de Brest; *Etel*, south-east of Lorient, the seat of a fishery school; *La Turballe*, *Guerande Batz*, and *La Pouliquen* to the west of St Nazaire; *Noirmoutier* on the Ile de Noirmoutier, with *Beauvoir-sur-Mer* on the mainland nearby; *Ile d'Yeu*, with *Croix de Vie* on the mainland; *Ars-en-Ré*, with *Lauxières* on the mainland; *Château d'Oléron* on the Ile d'Oléron, with *Le Chapus* and *La Tremblade* on the mainland nearby; *St Palais* on the north shore of the lower Gironde; *Libourne*, up the Dordogne; and *Ciboure* near St Jean-de-Luz. Many of these little ports are seaside resorts, and some engage in fishing on a considerable scale.

*For bibliographical note see pp. 220–22.*





Plate 40. Bayonne: the old town (looking south)

The larger river is the Adour, crossed by the Pont St Esprit, and the smaller river is the Nive. On the farther side of the Adour can be seen the Quai Place d'Armes and on the nearer side the Quai de Lesseps. The Pont St Esprit marks the limit of navigation. (For map see p. 154.)



Plate 41. Port-Vendres (looking seawards)

The nearer basin is the Nouvelle Darse, on the farther side of which construction work is proceeding on the Quai de la Presqu'île (now completed). The Algerian packet steamer is seen departing. (For map see p. 163).





Plate 42. Sète (looking south-east)

In the centre is the newer part of the town, with the broad Canal Maritime to the left and the Canal de Sète to the right. The old town lies on the lower slopes of Mont St Clair on the extreme right. Running across the picture is the Canal Latéral, on the nearer side of which is the town station, overlooking, in the immediate foreground, a bay of the Etang de Thau. (For map see p. 168)



## Chapter III

### MEDITERRANEAN PORTS

Port-Vendres: Sète: Port-St Louis-du-Rhône: Marseilles and subsidiary ports:  
Toulon: Nice: Minor Ports of the Mediterranean: Future developments in French  
ports: Bibliographical Note: Trade of the French ports

#### PORT- VENDRES

(See Fig. 41; Plate 41)

##### *General Description*

Lying 15 km. from the Spanish frontier, Port-Vendres is the nearest French port to Oran. The town is small, having a population of only 3,000. The harbour is situated on a rocky coast, where the Albères range, one of the eastern ranges of the Pyrenees, culminates in Cap Béar. Access to the port is always easy and no swell enters. From September to April, when northerly winds blow, the current sets to the south-east and attains as much as 5 knots.

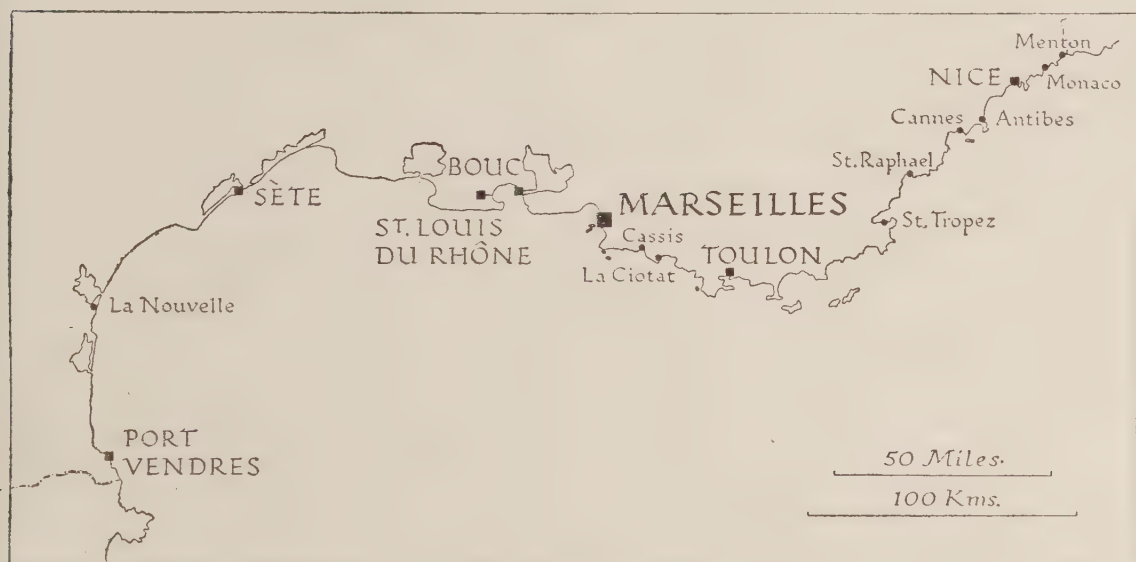


Fig. 40. The Mediterranean ports of France

The very small ports are not shown (see p. 212).

##### *Detailed Description*

The harbour faces north-east, and is largely enclosed by high hills. These hills, however, restrict the area of the harbour and limit the amount of ground suitable for railways. The maximum length for ships using the port is 150 m. (492 ft.), and the maximum draught



8.0 m. (26.25 ft.). There are one berth for vessels drawing 8.0 m., and five for vessels drawing more than 6.0 m. (19.7 ft.) but less than 8.0 m. in three basins—the Avant-port, Nouvelle Darse and Vieux Port. The avant-port is entered between the head of a breakwater projecting north-westward from the eastern side of the harbour, and Pointe du Fanal 226 m. to the south-west, over a depth of 9.5 m. (31 ft.). The Vieux Port (or Bassin de l'Obélisque) is a poor anchorage, as it lies open to violent north-east winds which blow down the valley at its head. Though there is a depth alongside of 4–6 m. (13–20 ft.), its 550 m. of quay are suitable only for fishing boats and small craft. The Nouvelle Darse, covering 6 ha., handles most of the traffic. The newest part of the harbour is the Quai de la Presqu'île, on the south side of the avant-port, recently constructed in conjunction with extensive railway improvements (see Plate 41).

	Depth		Accommodation for sea-going ships			
			No. of berths	Permitted draught		Quayage m.
	m.	ft.		m.	ft.	
Avant-port	8.8–14.0	29–46	1	Over 8.0	26.25	200
Nouvelle Darse	8.8	29.0	5	Over 6.0	19.7	750

There are no cranes or tugs at the port. There are three quays in the Nouvelle Darse—Ville, 320 m. long, Castellane, 135 m. and Douane, 330 m. The Ville quay has no railway connexion, and is used for the discharge of Spanish wine and Chilean nitrates. The Castellane quay receives the Algerian packet boats and handles the import of vegetables and grains and the export of machinery and vehicles. The reinforced concrete warehouse, 130 × 15 m., serves as a Gare Maritime; erected in 1929, it is the only warehouse in the port. Owing to the restricted amount of flat ground, the single railway line serving this quay has to negotiate the south-eastern corner by means of a turn-table. The Douane quay, which handles heavy imports such as timber and coastwise coal, is served by two tracks which reach the main line by a very heavy gradient on a sharp curve. The new Quai de la Presqu'île has been provided with a better rail connexion having a reduced curve and gradient. Work is in progress upon a new Gare Maritime (130 × 30 m.) on this quay, and upon the provision of much-needed flat ground for railway sidings and storage space, together with a new road from the town station to the quay, to replace the steep hill leading to the old harbour station. Projected

additions to the port works include, besides general improvement of depths, the construction of a mole from the western side of the harbour entrance, to narrow the opening to 130 m. Although little fishing is done from Port-Vendres, a slipway for careening trawlers and coasters is to be constructed in the bay near the gas works, for so far no such facilities are available on this coast except at Sète.

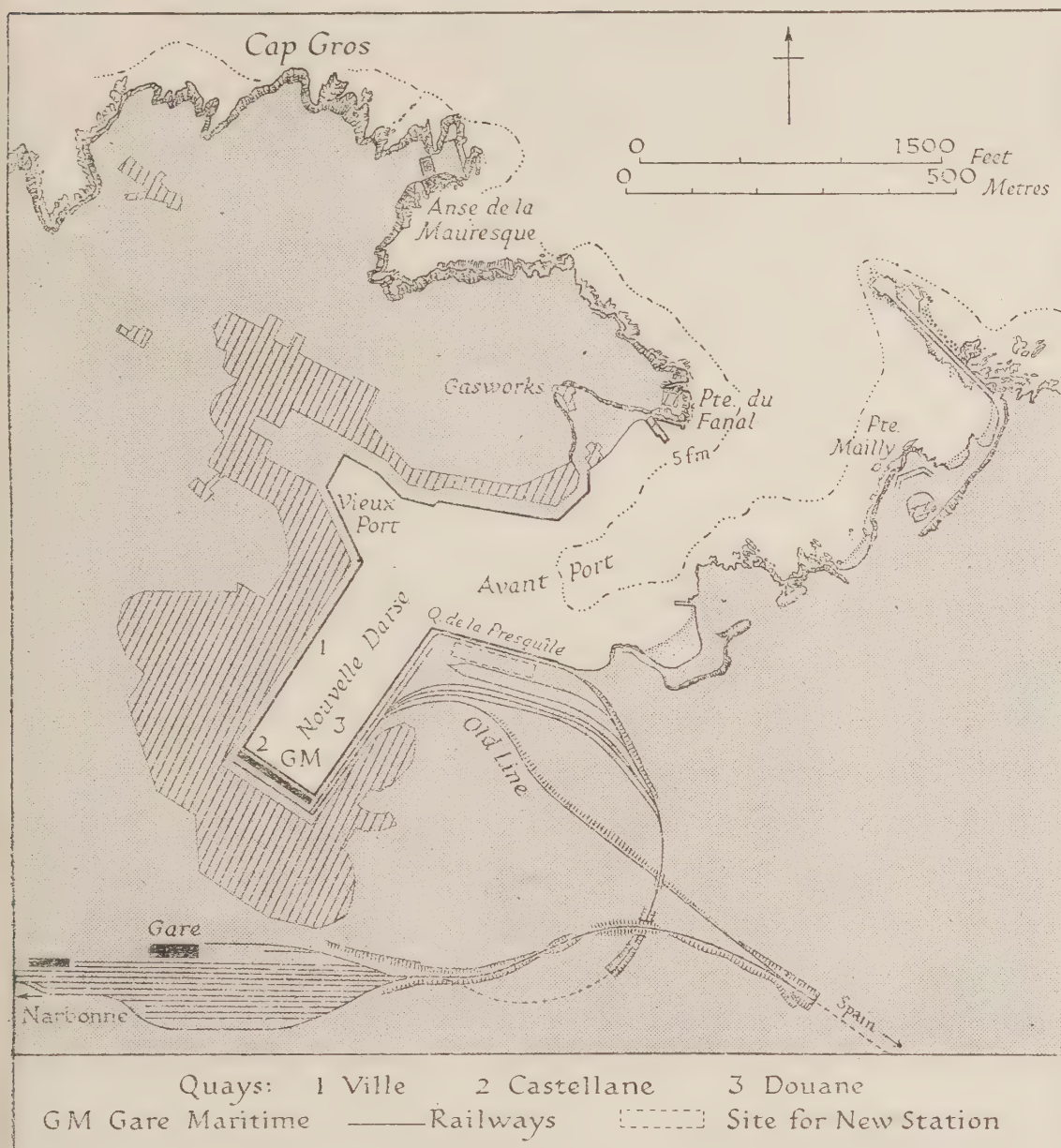


Fig. 41. Port-Vendres

## History

Port-Vendres remained for centuries little more than a creek, until revived by two great Marshals of France—Vauban and de Mailly. In 1679 Vauban noted the value of the site, and works were commenced in 1693. In 1772, de Mailly increased the depth of the old basin to



6 m. (19.5 ft.), and in 1789 quay walls were built. The new basin was completed in 1842, with a depth of 6 m.; 10 years later its depth was increased to 9 m. (29.5 ft.), and at the same time the entrance channel was made 110 m. wide and 800 m. long and the mole was constructed.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	103.2
Exports	12.8
Total	116.0
Coastwise trade (total)	11.9
Total sea-borne trade	127.9

In the present century prosperity has varied. The tonnage of goods passing through the port from 1900 to 1902 (annual average) was 114,000; in 1921 it had fallen to 43,000, but in recent years has again exceeded the figure of 100,000. Port-Vendres is the third French Mediterranean port after Marseilles and Sète, but is very much less important. Imports consist of cereals, maize, fruit, vegetables, and wine (all chiefly from Algeria), locust beans from the Levant, timber from Yugo-Slavia, Rumania and the Baltic, nitrates from Chile, and coal from England, together with a variety of goods in occasional shiploads and small parcels. The imports of Algerian fruit have shown an increase in recent years. The exports are much smaller in quantity, and amount to about 15 % of the total tonnage of trade. They consist chiefly of distilled alcohol, clothing and motor cars, and for the most part are destined for North Africa, fluctuating in amount according to the state of trade there. Formerly, iron ore from the Pyrenees was exported to Italy, Spain and England, but at present no bulk commodity uses the port. Port-Vendres is much more important as a packet station, as it provides the shortest and smoothest sea crossing to Algeria, and as a mail and passenger port its activity is increasing. The travellers number about 100,000 each year, having risen from 26,000 in 1900, and inward and outward journeys approximately balance. Rather more than half of the passengers travel to Algiers, and the rest are bound for Oran. A few trawlers from Marseilles land fish at Port-Vendres, to the extent of about 20 tons annually.

The advantageous position of Port-Vendres for the packet service is a drawback for cargo trade in that it is relatively distant from important centres of population, and Languedoc is adequately served

by Sète. During the period when Port-Vendres came within the economic region of Toulouse, the inland city developed some ambition to make the port an outlet for its own region; a few years ago, however, Port-Vendres and the department of Pyrénées-Orientales were transferred to the Montpellier region.

### *Communications*

The relief of the site presents serious problems for railway transport, even with the moderate tonnage of goods handled by the port at present, and may limit any conceivable future expansion. Most imports are dispatched by rail to Narbonne and farther eastwards, and the rest by road. Fast train services to Toulouse and Bordeaux westwards, and to the Rhône valley eastwards, make connexions with the packet steamers, and special through coaches are run to more distant destinations.

## SÈTE

(See Fig. 43; Plates 42, 43, 44)

### *General Description*

Sète (pop. 37,000) is the second port in importance along the Mediterranean coast of France. Its site is perhaps the most curious of any French port. Between the few rocky hills which cross the plains of Lower Languedoc to reach the coast at Agde, Sète and other points, are low and narrow beaches. Behind these beaches lie enclosed lagoons, like the Etang de Thau and Etang de Leucate, entered from the sea only by inlets known as *graus*. Sète stands on one of these beaches, where a channel connects the Etang de Thau with the sea; to the west the low hill of St Clair rises to 80 m.

The current in the entrance channels usually sets south-westwards and attains a rate of 3–4 knots, but with strong north-westerly winds the water flows out of the Etang de Thau, and with winds from seaward it flows into the lagoon; these movements attain a similar rate. The level of the sea usually varies by no more than 0.2 m.

### *Detailed Description*

Seawards the harbour is protected by a breakwater from the south-east winds which blow for two months in the year. It is always easy of access, and for the greater part can accommodate vessels drawing not more than 7.3 m. (24 ft.). Covering 45 ha., the harbour consists



of the Avant Port, Ancien Bassin and Nouveau Bassin; it is connected with the Etang by the Canal de Sète and by the Canal Maritime, which latter also opens into the Peyrade Canal leading north-eastwards towards the Rhône. In the port itself these canals, for much of their length, are widened and used as docks (see Plate 43).

### *Berthing Accommodation*

No. of berths for sea-going ships	Draught at berths	
	m.	ft.
40	7.3	24
6	6.0	19.7

Details of the basins, canals, and quays are as follows:

Basin or canal	Area	Length	Width	Entrance width (basin), bridge width (canal)		Draught possible		Length of quayage
	ha.	m.	m.	m.	ft.	m.	ft.	m.
Nouveau Bassin	7.0	320-90	—	55	180	7.3	24	924
Bassin aux pétroles	1.3	130	—	80	262	7.3	24	314
Chenal (Canal de Sète south of 1st swing bridge)	2.5	440	37-80	—	—	6.0-7.3	19.7-24	903
Canal de Sète (north part)	—	820	33-60	12	39	7.3	24	—
Bassin du Midi (south quays)	3.75	540	100	—	—	7.3	24	—
Canal Maritime	7.5	785	100-55	40-30	131-98	6.0-7.3	19.7-24	1,587
Canal Latéral	5.4	540	100	—	—	6.0-7.3	19.7-24	508
Ancien Bassin	8.0	410	200	200	—	4.0-7.0	10-23	938
Peyrade Bassin	—	—	—	—	—	2.0	6.5	—

Of the total length of quays of 5,150 m., 4,780 m. are able to accommodate sea-going ships and 2,040 m. are equipped with railways. Certain of the docks suffer from limitations. The quays of the Ancien Bassin can only accommodate small ships. The Nouveau Bassin cannot be entered by vessels more than 143.25 m. (470 ft.) long, as it is difficult to turn larger craft. The Bassin du Midi, which is used for heavy goods such as coal, pyrites and phosphates, is quayed only on the south side. The entrance to the Canal Latéral is divided by the pivot of a swing bridge into two parts, 21 m. (69 ft.) and 30 m. (98 ft.) wide respectively. Towards the Etang de Thau the Canal de Sète is crossed by two bascule bridges, Pont Sadi-Carnot and Pont du Midi, with openings 40 m. (128 ft.) and 30 m. (98 ft.) wide, and carrying the road and railway.

The Etang de Thau is becoming more important as an adjunct to the port of Sète. Entered from the sea by the Canal de Sète, it

has eastward connexions to the Rhône by the Canal des Etangs and westward connexions by the Canal du Midi. In the eastern part is an extension of the lagoon, the Etang des Eaux Blanches. Nearly the whole of the eastern side of the Etang des Eaux Blanches is quayed, and along it lie a number of factories. At the northern end is a small harbour, with depths of 1·8 m. (6 ft.), where there is a small oil refinery.

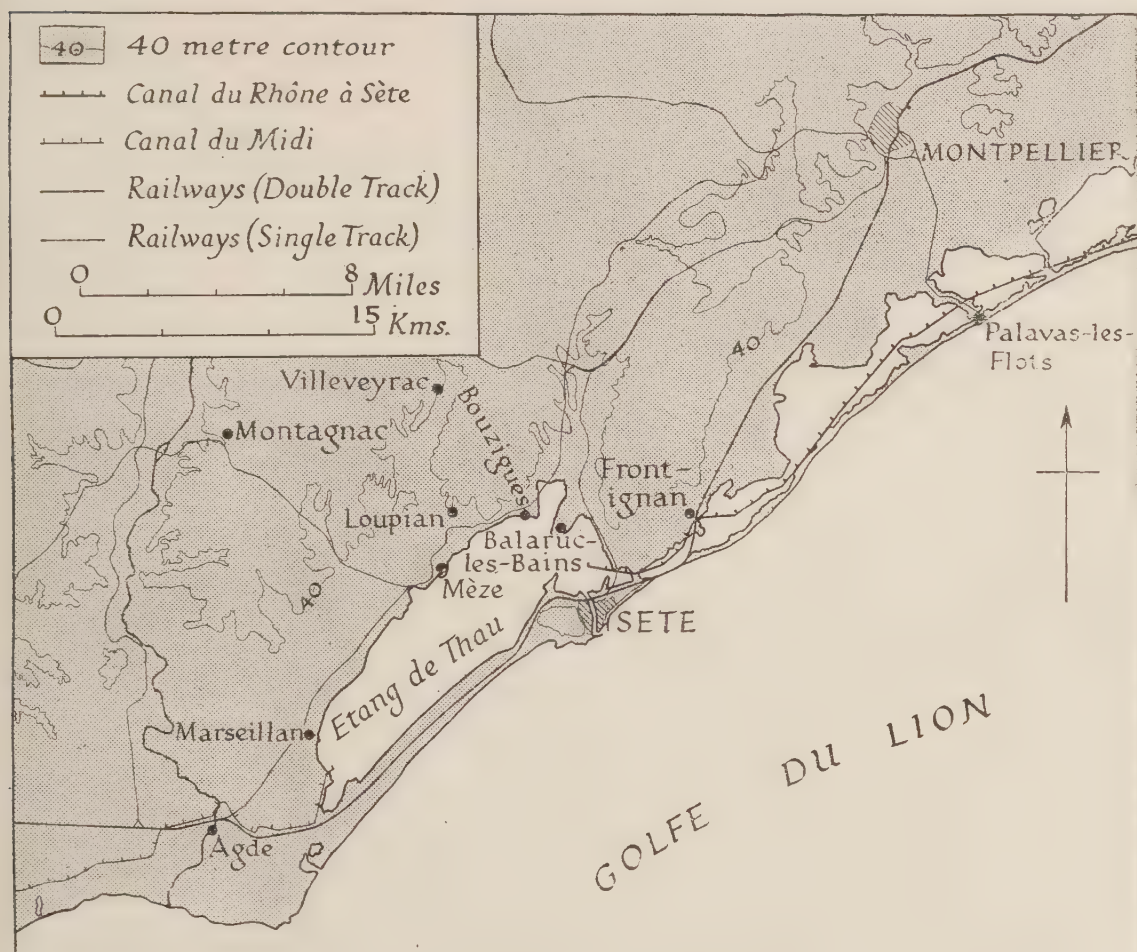


Fig. 42. The position of Sète

The Etang de Thau as a whole is accessible to vessels drawing less than 3·0 m. (10 ft.), but a marked channel and a turning area dredged to 8 m. (26 ft.) depth leads to the wharves at the eastern side of the lagoon from the inner end of the Canal de Sète. Small harbours are found at other points on the shores of the lagoon; a jetty at Pointe Balaruc, 61 m. long, is used by steamers which ply in the lagoon; Port de Bouzigues has a small harbour formed by piers, with depths from 2·0 to 1·4 m. (6·5 to 4·5 ft.); Port de Mèze, consisting of a basin 290 m. long, has depths of 3·0 m. (10 ft.); Port de Marseillan has depths dredged to 3·0 m. (10 ft.).





### *Port Facilities*

Cranes under 5 tons number five, while there are also six floating cranes with capacities up to 5 tons, one 10-ton hand-crane and a pontoon steam sheers of 35 tons. Repairs can be carried out only for small ships; no dry dock exists, although there are five pontoons for heaving down vessels of 1,200 tons. There are eleven tugs in the port.

### *History*

The ancient ports on the coast of Languedoc—Aigues-Mortes, Agde and Narbonne la Romaine—had become useless by the sixteenth century owing to the silting up of their harbours. Henry IV intended to create a port on this coast, but abandoned the project in 1596, and it was not until 1663 that 'Cap de Sète' was selected as the site for a harbour of refuge. Eventually in 1666 Sète was founded as an artificial port by Louis XIV, at the suggestion of Colbert and Vauban. A mole, 550 m. long, was constructed, and the inlet connecting the Etang de Thau with the sea was canalized, works which were completed by 1677, while shortly after a second mole was built.

The early years of the nineteenth century saw extensive works undertaken, and by 1822 the old mole had been turned into a jetty, while a second jetty converging towards it and a breakwater had been completed. In 1839 an English company built the railway from Sète to Montpellier, and in 1859 the Bassin de la Compagnie du Midi was completed. For many years little but routine improvements were carried out, but during the war of 1914-18 measures were taken for handling Swiss traffic and after the war considerable extensions were undertaken to improve access to the Etang de Thau. By about 1931 virtually an additional port had been created, and oil tankers can now proceed to the eastern end of the lagoon. In September 1940 it was reported that a new mole was being constructed at Sète. Eventually, it is intended to provide port extensions from Barrou Point to Balaruc Peninsula.

The town of Sète grew up first on the lower slopes of the hill to the west of the entrance to the lagoon, Mont St Clair. The newer part lies on the sand spit to the east, and is steadily expanding, growing especially along the Montpellier road.



*Trade**Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	962.0
Exports	189.5
Total	1,151.5
Coastwise trade (total)	72.6
Total sea-borne trade	1,224.1
Total foreign trade 1938 (provisional figures)	1,648.7

As with most French ports, the import of fuels is considerable. The coal imported from England is used for gas manufacture, and of the petroleum import the greater part is moved to the refinery at Frontignan. Nearly one-third of the weight of imports consists of various heavy chemicals, in a crude or semi-manufactured state—coal-tar pitch, sulphur, phosphates and nitrates, copper sulphate, etc.; many of these are used in the vine-growing district nearby. A considerable proportion of the imports is accounted for by the single commodity of wine, which comes mainly from Algeria and Italy. Foodstuffs amount to just over 10 % of imports, and consist principally of fruits and potatoes. Apart from timber and a certain amount of wool, the remaining imports are miscellaneous items, and include very few manufactures.

Exports are much smaller in weight and consist mainly of mineral and chemical products. The largest item is that of metals and ores, including small quantities of iron and zinc, and a considerable amount of bauxite. Phosphatic fertilizers and tar and tar products are next in order of weight, together with a big weight of miscellaneous chemicals, such as sulphur, ammonium sulphate, calcium carbide and copper sulphate. Among other exports manufactured goods appear in some variety, but count for very little in weight. The export of wine fluctuates very considerably; it has declined from much higher figures in the latter part of the nineteenth century to very small proportions.

Although there is a service of packet boats to Algeria via Port-Vendres, the passenger traffic is small and amounts only to a few hundred passengers annually.

*Industries*

Industrial development has increased in recent years. The shores of the Etang de Thau offer ample sites for factories, especially those which require plenty of ground. There are distilleries and cooperage

works, and a repair yard for rolling stock, but the chief expansion has been in the petroleum refining, chemical and cement industries, and now these occupy 65 ha. along the shores of the lagoon. In 1897 the firm of Schneider-Creusot set up blast furnaces and steel works for using iron ore from Algeria, but these were shut down in 1904 and are now derelict. There are important salt works on the shore of the Etang and several more to the south-west. The refinery at Frontignan, 7 km. distant, has an annual capacity of 300,000 tons (see Plate 44).

The immediate hinterland of Sète is an active region economically, but not important enough to sustain a first-class port. In most attempts to capture distant trade, Marseilles is more successful than Sète, for its facilities are superior and its sailings are more frequent. Sète is a liner port only to a very small extent, and seems to be developing mainly in the direction of heavy bulk cargoes. Nevertheless, it maintains some function as a transit point for Switzerland, and at times even handles traffic destined for the German canals. With the future expansion of hydro-electricity supplies in the eastern Pyrenees and southern parts of the Central Massif, Sète should prosper. Not only is it a convenient port for industries located inland, but also its own industries should provide for connexions with electro-chemical industries. Hydro-electrical development may eventually allow the nearby bauxite supplies at Loupian and Villeveyrac to be treated locally.

### *Communications*

There are 6.6 km. of railway in the port together with two sorting yards. Connexions are made eastwards to Montpellier and south-westwards to Narbonne, and thence either to the Spanish frontier or Toulouse. Canals play a considerable part in transport in the region; the Rhône-Sète Canal, which takes 600-ton barges, and the Canal du Midi, which takes 160-ton barges, carry annually over 100,000 tons of merchandise. A considerable amount of the oil import is moved to the refinery at Frontignan by pipe-line. Road transport is responsible for moving most tonnage, however, and sometimes handles as much as half the total; the railways handle about one-quarter, and the canals and pipe-line each take one-eighth.



## PORT-ST LOUIS-DU-RHÔNE

(See Figs. 44, 45)

*General Description*

Port-St Louis-du-Rhône (pop. 4,500) is a secondary port, of some interest as the only harbour in the Rhône delta which is in use by ships of any size. As the mouth of the river itself is impracticable on account of the bar, the entrance is by way of a ship canal.

From its position close to the mouth of the Rhône, St Louis might be expected to have become a maritime port of some magnitude, but two factors militate against much further development. The first is the physical obstacle which arises from silting in the Rhône and adjacent waters, and from the irregular flow of the river. The other is the dominance of Marseilles in the trade of south-eastern France, shown clearly enough by the fact that the port of Bouc on the eastern

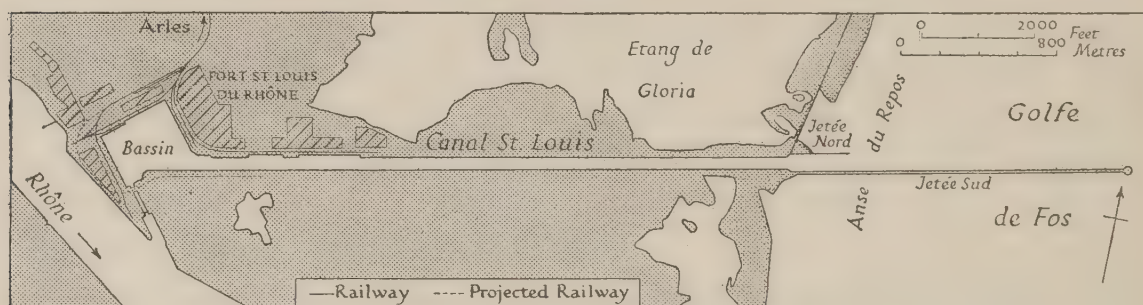


Fig. 44. Canal St Louis

shore of the Golfe de Fos, for long the outlet of Arles, is now within its jurisdiction. With any further development of the Rhône waterway, however, St Louis should experience an increase of its river and coastwise trade, although the drawbacks of its physical setting would still operate.

Between the delta and the high land of the Collines de Martigues lies the Golfe de Fos, entered between the eastern arm of the delta to the west, and the low Cap Couronne to the east. Little shelter can be found in this gulf, for all winds blow into it. The currents are generally weak and are much influenced by the wind. In the north-west is the Anse du Repos, a roadstead which offers fair anchorage, with depths of about 9 m. (29.5 ft.), 1,280 m. offshore. From a point on this shore the Canal St Louis, 5.5 km. long, leads westwards to the Rhône; the southern side of the canal is prolonged into the sea by a jetty extending about 1,750 m. The canal has a depth of 7.5 m. (24.5 ft.); the width is 63 m. on the surface, and

24.4 m. (80 ft.) at the bottom. Northerly or north-westerly winds occasionally lower the level of the canal by as much as 0.6 m. (2 ft.); south-easterly winds tend to raise the level.

At the entrance is the small harbour of Repos, within the protection afforded by the jetties.

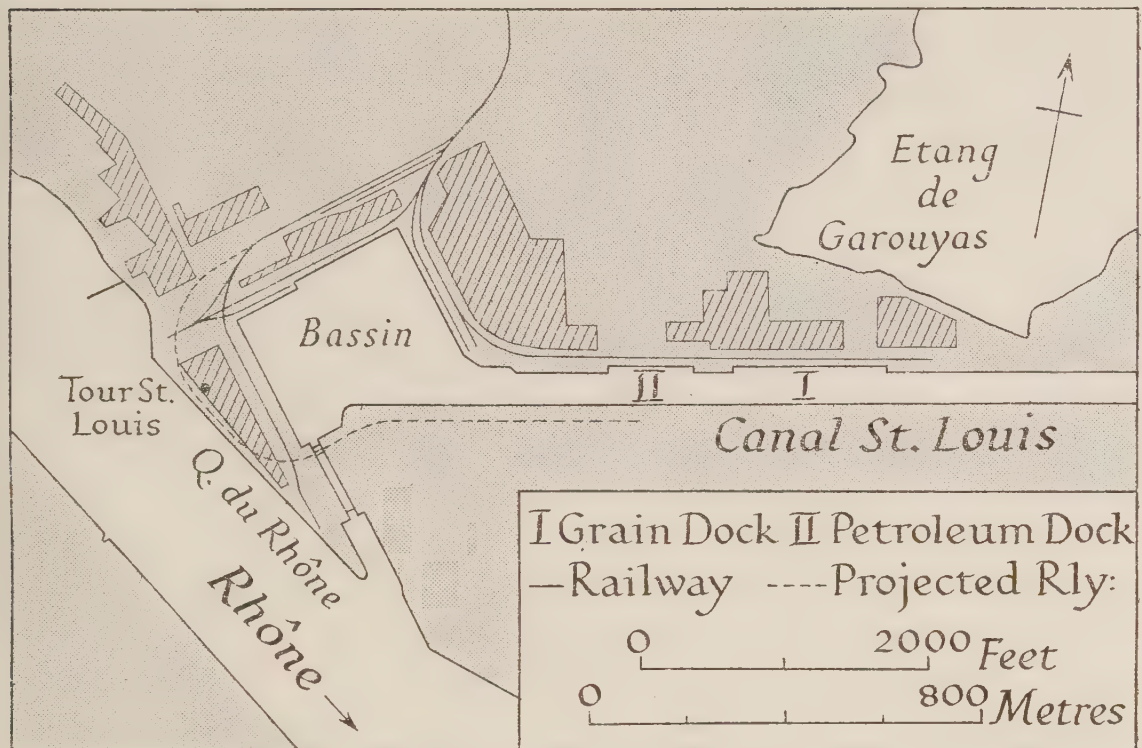


Fig. 45. Port-St Louis-du-Rhône

### Detailed Description

On the north bank of the canal itself there are two basins with 630 m. of quay. The 'Garage Pétrolier', or petroleum basin, can be used by tankers 130 m. (426 ft.) long and drawing 6.4 m. (21 ft.). A grain basin, 300 m. long, is equipped with fairly modern appliances, and provides two berths with depths of 7.0 m. (23 ft.). These berths lie a short distance to the east of the Bassin de St Louis.

The principal part of the port is the Bassin de St Louis, and lies at the westward end of the canal. It is connected with the Rhône, at a point where the river reaches a width of 335 m., by means of a channel 60 m. (197 ft.) wide. The exit into the river is through a lock 160.0 m. (525 ft.) long and 21.9 m. (71.8 ft.) wide, crossed by a bascule road bridge. Along the river bank the Quai du Rhône has depths of 4.5 m. (14.8 ft.) alongside. The Bassin de St Louis has an area of 12 ha., and is 400 m. long and 300 m. wide; there are 856 m. of



quays, with depths alongside of 6.0 m. (19.5 ft.), although the depths in the centre of the basin reach 7.5 m. (24.5 ft.). Vessels lie alongside the quays without anchoring. There are ten berths permitting a draught of 6.0 m. and three berths permitting a draught of 7 m. (23 ft.). Tankers proceeding to the petroleum berth enter the basin first in order to turn before berthing.

### *Port Facilities*

The port is equipped with eight 3-ton steam cranes and one 5-ton floating crane, as well as a 40-ton crane not in good condition. Projected improvements to the port include the provision of electric cranes. The area of storage grounds is about 5 ha.; there is also some shed accommodation. The normal oil-storage equipment consists of 123 tanks with 94,500 cu.m. capacity.

### *History*

For many centuries questions of harbour facilities in the Rhône delta were the concern of the city of Arles, some distance to the north. In Roman times Arles was served by two ports, one on the Rhône and one on the Golfe de Fos, but after periods of prosperity in the Middle Ages both subsequently declined. At the end of the seventeenth century Vauban advised the construction of a canal to connect Arles with Bouc, the port on the eastern side of the gulf, in order to give the city an improved maritime connexion. This work was undertaken in the early nineteenth century, being completed in 1834, but evidently was not sufficient for its purpose: in 1852 an attempt was made to improve the Rhône outlet by prolonging the dykes which confined its egress, but in 1863 the depth on the bar was only 1.2 m. (3.9 ft.). In the next year work on the Canal St Louis was commenced, and reached completion in 1871.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	268.3
Exports	59.5
Total	327.8
Coastwise trade (total)	505.6
Total sea-borne trade	833.4
Total foreign trade 1938 (provisional figures)	564.6

The foreign trade of Port-St Louis-du-Rhône increased until 1929, reaching a maximum of 740,000 tons of cargo. Since then there





Plate 43. Sète: the Canal Maritime (looking north to the Canal Latéral)

The canal is crossed by the Passin Peyrade in the middle distance. (The bridge in the foreground, which also appears in Plate 42, has since been demolished.) (For map see p. 168.)



Plate 44. The Frontignan oil refinery (looking south-west)

Beyond the refinery can be seen the low beaches and lagoons which characterize this coast, and farther away is Mont St Clair behind Sète. The refinery is 7 km. distant from Sète, with which it is connected by pipe-line. (For map see p. 167.)



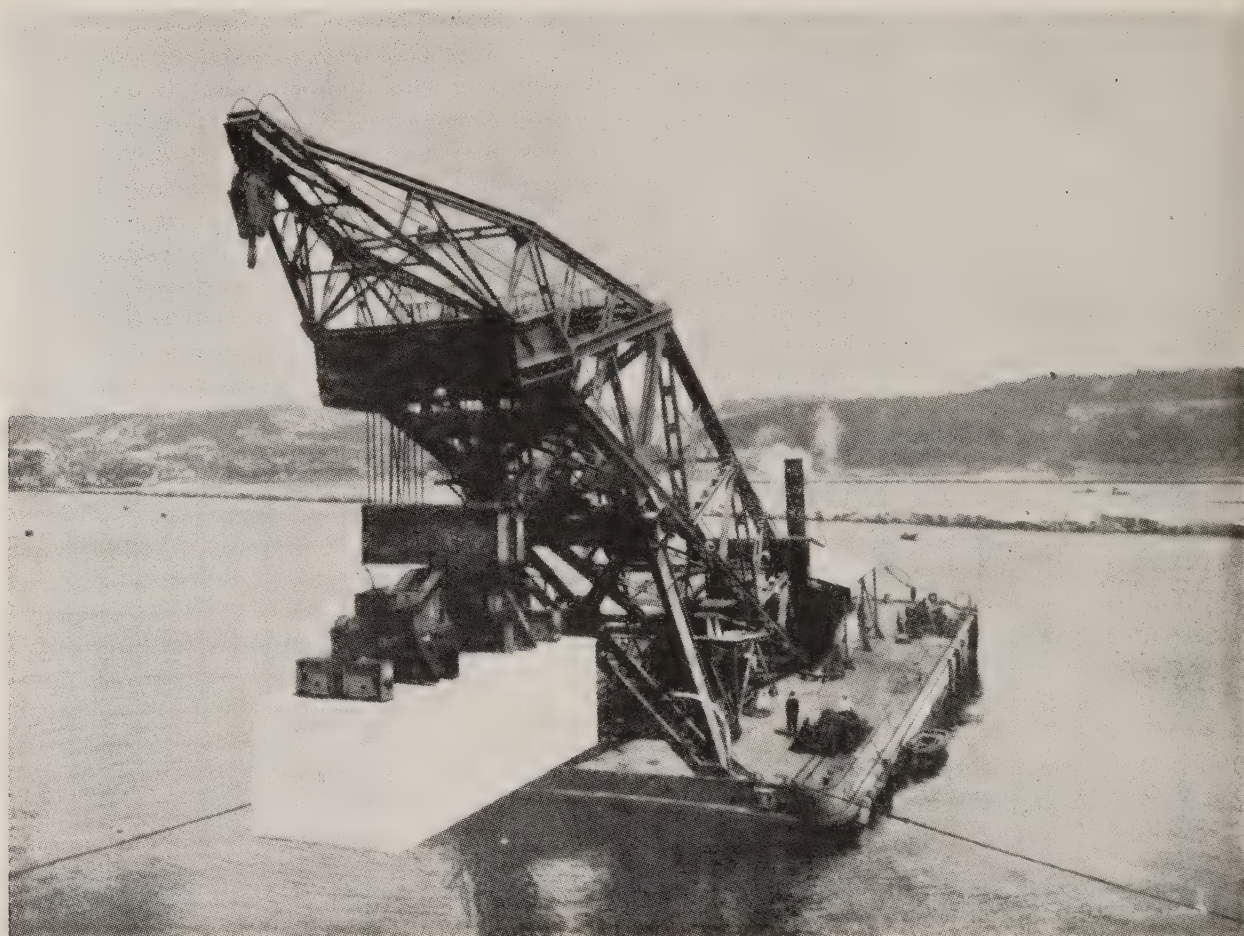


Plate 45. Marseilles: extensions at the northern end of the port (Bassin Mirabeau)  
The floating crane is laying a 350-ton block (the largest used weigh 450 tons). This crane is operated by Messrs Werf Gusto, of Schiedam, Netherlands. Behind the crane can be seen the inner breakwater, one of the line of breakwaters forming the seaward protection to the Marseilles-Rhône Canal. Close inshore is the site of the Mourepiane reclamation works. (For map see p. 176.)

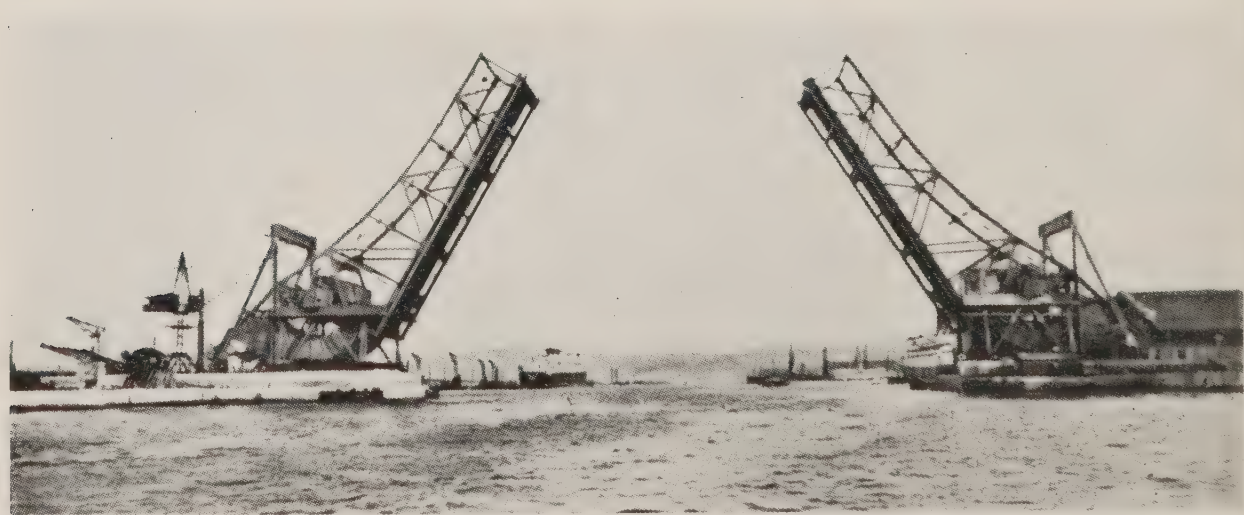


Plate 46. Marseilles: the Pinède bascule bridge (looking north-west from the Bassin National into the Bassin de la Pinède)

The clearance width of this passage is 70 m. (230 ft.). (For map see p. 177.)

has been a decline to a figure of 300,000–500,000 tons, of which the imports are more than double the weight of exports. The trade is fairly typical of a smaller French port: among the imports fuels are the largest item, mostly oil; next, in order, come wine, phosphates, cereals, minerals and timber. Of the exports cement provides much of the tonnage; there is some re-export of oil, but apart from this only small quantities of salt, fodder and cereals are of any importance.

### *Communications*

There are 9 km. of railway serving the port and connected with a line to Arles. It is hoped that eventually the railway will be extended to the south side of the basin and the canal so as to develop sites for factories. Most of the freight movement in and out of St Louis is by rail, but a considerable quantity, amounting to one-third of the total in some years, is moved by river and canal transport. Much of the activity of the port is concerned with trans-shipment of cargoes from maritime to river craft. A big passing traffic arises through the activities of the *Solvay* factory at *Giraud Barcarin*, 6 km. up the Rhône, which exports soda and imports limestone in coasting vessels from the small Mediterranean port of Cassis. Giraud Barcarin has no foreign trade, but its coastwise imports amounts to over 10,000 tons annually.

## MARSEILLES AND SUBSIDIARY PORTS

(See Figs. 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 65;  
Plates 45, 46, 47, 48, 49, 50, 51, 64)

### *General Description*

Marseilles (pop. 914,000) is the second largest city and principal port of France, and the largest port in the Mediterranean. It is dominant particularly in all the Mediterranean, African and Eastern trades. The remarkable growth in the population of Marseilles is proof that its economic activity is extremely vigorous. Few cities in Europe have grown so rapidly in recent decades, and in the 10 years from 1926 to 1936 the expansion was at the rate of almost 50 %—from 652,000 to 914,000. The total population of the city and adjoining towns, not counting the annexed ports, is almost a million. For the future, the trade of Marseilles and its satellites seems to have fair prospects. The Mediterranean, African and Eastern trade routes will hardly diminish in importance, and the Near East



is now established as an important centre of petroleum production. At the beginning of this century heavy industry and bulky goods were the main factors governing trade routes, but technical changes in recent decades have increased the importance of light industries, which are much less tied to the coalfields. The effects of this change, together with the proximity of hydro-electricity supplies, and the decentralization of French industry, should tend to redress the effects of remoteness from a productive hinterland.

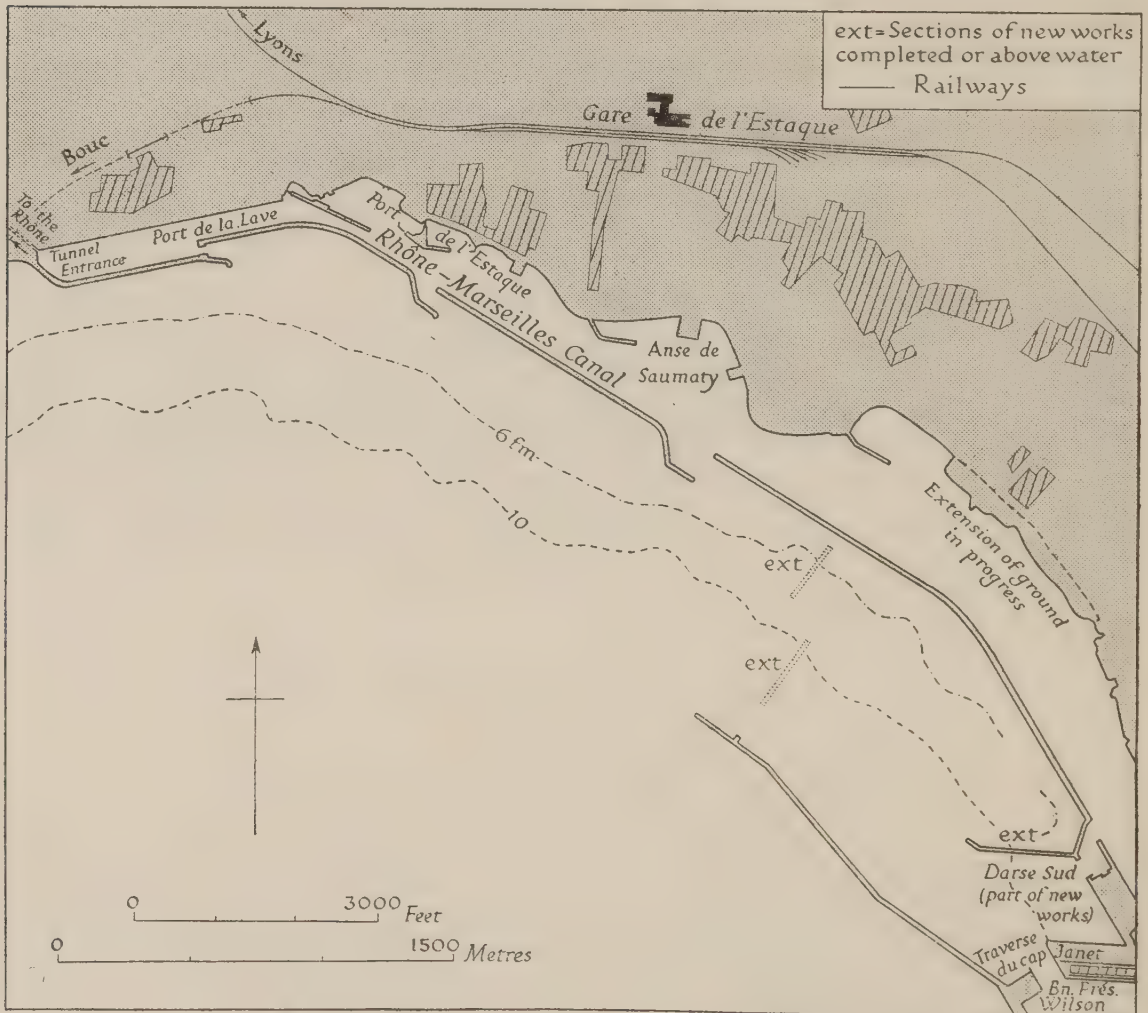


Fig. 46. Marseilles, north. (See also Fig. 47)

Among the French ports, Marseilles has always been characterized by a certain metropolitan outlook, which is emphasized by its variety of commercial contacts and by the many foreign elements in its population. The successful maintenance of a big port distant from the chief centres of population is an achievement which indicates an unusual energy and initiative among its citizens. Indeed, a French historian has declared that 'nothing of importance goes on in the world without the name of Marseilles being connected with it'.

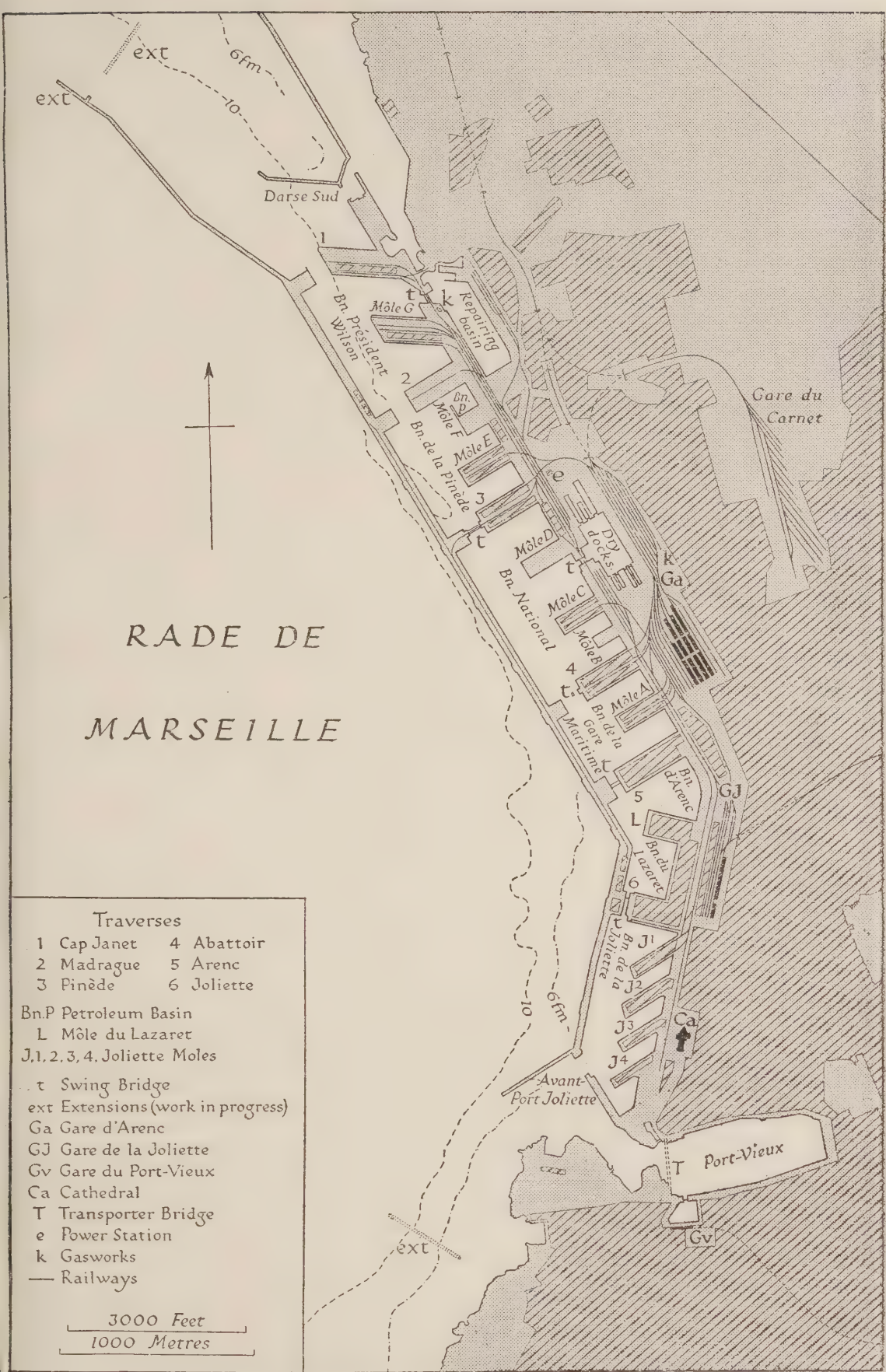


Fig. 47. Marseilles, south (see also Fig. 46)

The swing bridges shown are bascule bridges.



Access to the roadstead is easy, and the currents in it are irregular and of no great strength. The chief natural advantages of the port are the deep water close inshore and a virtual absence of any tidal range. The basins of the port, therefore, are different in function from those of the northern ports, and locks are not required. There are few difficulties arising from entrance channels to compare with those experienced by Nantes or Bordeaux. The two principal problems of the port are very different: they arise from the need to build the basins and breakwaters out into comparatively deep water, an operation requiring enormous quantities of material, and from the proximity of steep hills to the shore, which restricts the amount of space available for the circulation of traffic and the development of industries.

### *Detailed Description*

In 1937 the port had a water area of 256 ha., 26 km. of quay, of which 18 can be used by ships, and a quay area of 116 ha. The old harbour, Port-Vieux, is of comparatively minor importance to-day, though until 1844 it was the principal part of the harbour. The constricted entrance makes it virtually a basin, 26 ha. in area. It is accessible to vessels drawing less than 5.5 m. (18 ft.). The deepest part of the entrance, with depths up to 7.5 m. (24.5 ft.), is reduced by rocks to a width of only 30.5 m. (100 ft.), while a transporter bridge limits the headroom to 49 m. (164 ft.). Since 1938 considerable improvements to the quays have been carried out; the east quay is being widened to 30 m. (98.5 ft.), of which 22 m. will be utilized for wharves and circulation ground; the north quay is being widened by 20 m. (65.5 ft.) to give a paved circulation width of 22 m. (72 ft.). There is a small careening basin with depths of 4.0–4.9 m. (13–16 ft.), and in the south-east corner are quays for vessels of 2.4 m. (8 ft.) draught. This harbour is used mainly by small coasting vessels.

The modern port has been formed by the construction of an outer breakwater-mole running approximately along the five-fathom line, and by the building of six moles out to the breakwater, at right angles to the shore, so as to form a succession of basins. These connecting structures, or 'Traverses', are about 90 m. wide, and are pierced by water passages which allow vessels to pass from one basin to another. Four of these passages are crossed by swing bridges. The breakwater has been extended progressively and is now over 5 km. long. It is 9 m. high; the inner side of the breakwater itself is a quay 30 m. wide. The north entrance is 105 m. (344.5 ft.) wide, and the south entrance 70 m. (230 ft.) wide. Extensions of the breakwater

and moles to the north and to the south have been made by throwing down masses of stone or concrete blocks and building the walls on the top of the rampart so formed (see Plate 45).

The port within the breakwater comprises seven basins, some of which contain interior moles:

Joliette, recently reconstructed, with four oblique moles.

Lazaret.

Arenc.

Gare Maritime, with one mole.

National, with three moles.

Pinède, with two moles.

Président Wilson, with one oblique mole.

Two basins under construction—Mirabeau to the north, and Pharo to the south.

In addition, two other basins lie behind these—the Bassin de Radoub (dry dock basin) opening from the National Basin, and the Bassin de Rémissage (repairing basin), opening from the Président Wilson basin.

The entrance depth of the Joliette basin is 9.0 m. (29.5 ft.) and the Président Wilson basin 20.0 m. (65.6 ft.). These two give access to the entire system of basins, from the south and the north respectively.

Basin	Water area ha.	Depths		Maximum length permitted m.
		m.	ft.	
Joliette	—	8.0–9.0	26.25–29.5	130
Lazaret	15	9.0	29.5	160
Arenc	—			
Gare Maritime	17			
National	40			
Pinède	27	9.5	31.1	200
Président Wilson	30	9.0–12.0	29.5–39.5	275
Work in progress:				
Mirabeau	160	9.1–18.3	30–60	—
Pharo	145	—	—	—

In the western part of the old south avant-port the depths are 7–7.9 m. (23–26 ft.), while the eastern part shoals. Pinède and Président Wilson basins are largely used by French and English lines to the East; the former includes a petroleum basin, and to the rear of the latter is a basin for floating timber. The Gare Maritime basin is the starting point for services to Morocco and Senegal. The Arenc basin is the most important for cargo traffic.

### *Port Facilities*

In 1939 there were in operation 220 cranes with a capacity over 5 tons, twenty-nine floating cranes up to 8 tons, and thirteen pontoon



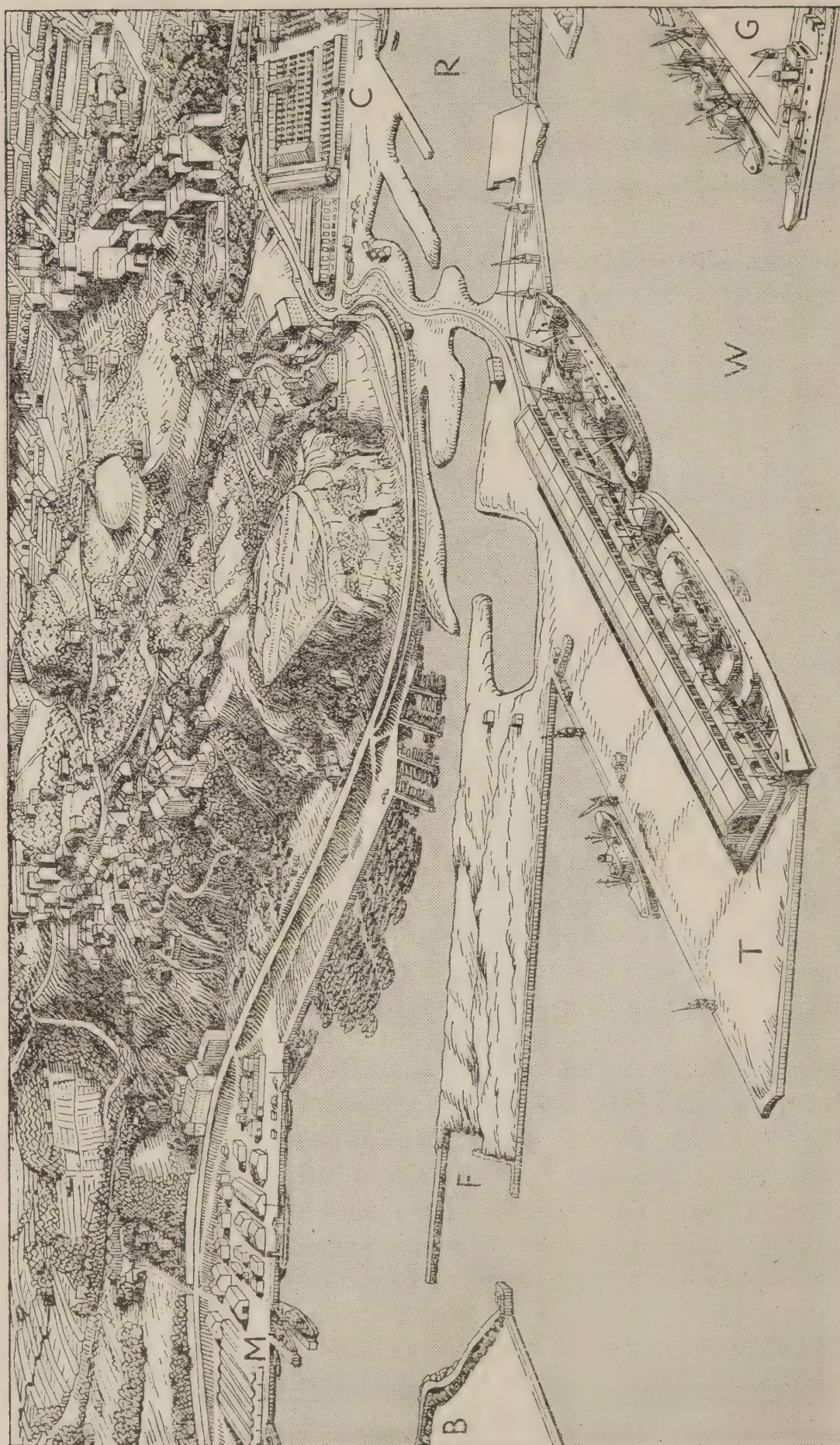


Fig. 48. Cap Janet, Marseilles (looking east)

*B*, north breakwater; *C*, cattle pens; *F*, reclamation in progress by filling in; *G*, mole; *M*, reclaimed ground, the site for the future Mourepiane shunting yard; *R*, Traverse du Cap Janet; *T*, repairing basin; *W*, part of Bassin Président Wilson. The railway can be seen on the left behind the cattle pens; later it enters a tunnel behind the ridge of high ground which culminates in Cap Janet. From this illustration it can be seen that the broken ground near the shore presents a problem in port planning.



lifting appliances, the three largest of which have capacities of 520, 400 and 150 tons, as well as a variety of elevators and lifting equipment for special commodities. Some of these special appliances have been installed to deal with the package trade with North Africa; Algeria and Tunisia, for example, send 8 million packages a year. Few of the quays are specialized, although 40 % of their length is reserved for specific companies. The warehouse accommodation is in keeping with the size of the port and the variety of its trade.

The port is equipped with seventy-three tugs and 710 lighters. There are large stocks of fuels, and oil fuel and Diesel oil are conducted to the quays by pipe-lines. There are seven dry docks situated behind the National basin: the largest of these has a bottom length of 204 m. (670 ft.), a width of 25 m. (82 ft.), and a depth of 9.0 m. (29.5 ft.). During 1934-8 the average number of ships using these dry docks was 675 (2.2 million tons) annually.

### *History*

Marseilles itself lies in the depression between the cretaceous Chaîne de St Cyr to the south-east and the Chaîne de la Nerthe to the north-west. In Oligocene times this depression was a lake; the basin was later drained westwards into the Golfe du Lion by a stream whose headwaters have dissected the old lake floor and whose lower submerged course now forms the old rock harbour of Marseilles. The town itself is built on the low hills which lie on three sides of the Old Port: conspicuous among these is the older limestone mass of Notre-Dame de la Garde, which, rising with abrupt slopes for more than 150 m. above the valley of the Huveaune, has acted as a sea-mark for centuries. In the seventeenth century the town began to spread and has continued further to cover these hills.

Marseilles was founded by the Phoenicians in 599 B.C., and for the remainder of the classical period was a port of considerable importance. In the disturbed times which followed, however, it became the object of successive invasions by Romans, Vandals and Burgundians. Later, like much of Provence, it suffered repeated raids by Saracen pirates. Although it grew rich as an embarkation port for some of the Crusades, it was much less important than other Mediterranean seaports, and failed to compete with Pisa, Genoa, and Venice. At this time the Rhône Corridor had nothing like the importance for communications which it was to acquire in modern times. Marseilles did not properly become a part of the French kingdom until 1471. The first quays date from 1511. In the seven-



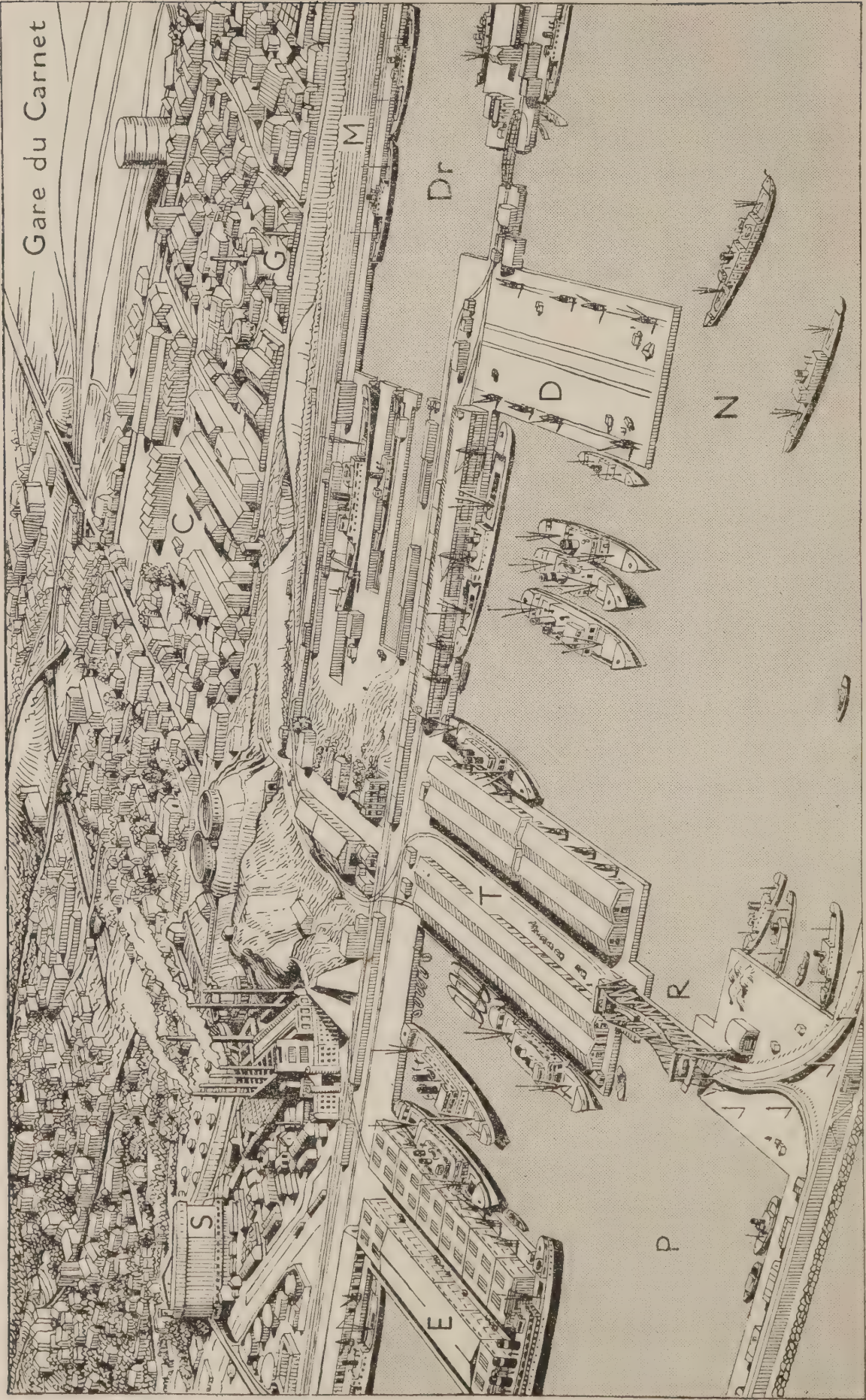


Fig. 49. (For description see p. 183)



teenth century it flourished under Colbert's active commercial policy although it could not rival Nantes and Bordeaux.

In spite of its ancient origins Marseilles is very much a port of the nineteenth and twentieth centuries. The conquest of Algeria which began in 1830 marked the first great stage in its progress. Improvements in what is now the old port had been carried out, until by 1842 this harbour had depths of 5·5–9 m. (18–29·5 ft.), but the effect of French penetration in Algeria was shown by an increase in port traffic of 40 % from 1830 to 1840. As a result the creation of the modern port was begun, and the Joliette basin came into use in 1847. At this time the tonnage of shipping using the port amounted to 3 million tons annually. The next year saw the completion of a canal for supplying the city with water from the Durance.

Shortly afterwards, the coming of the railways contributed enormously to the growth of Marseilles, by linking it with distant centres of population and allowing it to take advantage of its favourable location for dealing with traffic to the Near East. In 1852 the railway from Avignon was completed, thus providing a connexion with Lyons and permitting rail transport for coal from the Alès coalfield. These developments were reflected in the commencement of work on the Gare Maritime basin in 1859. In the same year the completion of the railway to Toulon marked a stage towards a rail connexion with Nice and the Italian frontier. Further expansion was necessary: in 1863 the National basin was authorized (although the moles were not finished until 1883), and the next year saw the opening of two more basins—Lazaret and Arenc. These extensions enabled the port to profit at once from the opening of the Suez Canal in 1869, which was a milestone in its history. Railway connexions with Paris and the Channel ports allowed it to increase its already considerable business as a mail and passenger port for Egypt and beyond—an importance which it retains to-day. A few years afterwards in the 'seventies the penetration of French power into Indo-China resulted

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Fig. 49. The Bassin National and central part of Marseilles, near the dry-dock basin and principal power station (looking east)

In the foreground can be seen part of the principal breakwater, while two vessels can be seen lying in the dry docks. *C*, engineering works of *Société Provençale de Constructions Navales*; *D*, mole *D*; *Dr*, dry dock basin; *E*, mole *E*; *G*, gasworks; *M*, the principal shunting yard handling dock-side traffic (*Gare de Formation des Trains*); *N*, Bassin National; *P*, Bassin de la Pinède; *R*, Bascule Bridge over the Pinède passage; *S*, silos; *T*, Traverse de la Pinède. The railway from the large newly constructed siding, *Gare du Carnet*, swings round to branch and pass through two short tunnels before joining the line from the dockside shunting yard, which also passes through a tunnel behind the power station.



in a further increase in its trade. In 1877 the completion of a railway to Grenoble via Aix provided a route through the Alps alternative to that through the Rhône valley, although less easy.

Marseilles suffered through the construction of the Alpine tunnels, for the Simplon and St Gothard afforded Genoa a competitive advantage in the Swiss traffic. On the other hand, the remarkable economic development of Algeria resulted in a great increase of cross-Mediterranean traffic, and the early part of this century saw very considerable dock developments. In 1900 the Pinède basin was opened, and in 1909 the Président Wilson basin was authorized. In 1915 a railway from l'Estaque to Port-de-Bouc and Miramas was completed: this line, difficult and costly to construct owing to the necessity for several tunnels, formed the last link in a duplicate connexion with Lyons, a link which had been started as long ago as 1873. In 1927 the Rove tunnel was opened, forming a canal connexion with the Rhône for large barges; work on this project had begun in 1911.

### *Recent Dock Developments*

In recent years further developments in the port, of enormous scope, have been undertaken or projected: (1) Improvements in the existing basins. (2) An extension to the south. (3) An extension to the north. (4) The development of the subsidiary ports around the Etang de Berre to the north-west (see pp. 192-200, 220).

(1) By 1932 the accommodation in the Joliette basin had become insufficient, and works were undertaken to enlarge the basin. The moles in the north end of the basin and the Traverse de la Major were removed, and by the construction of the Digue St Jean at the south end, the old south avant-port was included and thus the enclosed area was nearly doubled. The Digue Ste Marie, over 300 m. long, has been constructed to protect the new avant-port Joliette seawards. Four oblique moles each 280 m. long have now been completed within this improved basin, well equipped with warehouses and railway connexions. The two-storey mole sheds are 250 m. long and laid out so that the cargo of a North African packet boat can be unloaded in  $1\frac{1}{2}$  hr. This remodelled basin will provide sixteen berths for liners with a depth of 8.5 m. (28 ft.) below low water together with 500 m. of quayage for coasting vessels, and extensive storage space. The moles vary in width between 50 and 72 m. On the old east quay a maritime railway station has been constructed with enclosed connexions to each of the sheds on the moles.

(2) The new extensions to the south consist of the Pharo basin, authorized in 1932, and representing a revival of a scheme proposed in the nineteenth century. A southern breakwater (*Digue des Catalans*), two immense parallel moles, a long access channel to the National basin, a vast avant-port to the south covering 200 ha., 4 km. of quays, and depths of 12–14 m. (39·5–46 ft.) are provided for in this great scheme. Work has been concentrated on the *Digue des Catalans*, and although it advanced slowly, costing 200,000 fr. per m., this breakwater is now largely complete.

(3) Developments to the north include a utilization of all possible dock sites at the extreme northern end of the port of Marseilles itself. The Mirabeau basin is the last extension possible to the north, for beyond it the water deepens too rapidly. Sanctioned in 1919, it will need very elaborate construction to give 6 km. of quays and 140 ha. of flat ground behind the quays at Mourepiane. Here it is intended to build two docks separated by a central mole, petroleum basins, and four large graving docks close to the Canal du Rhône. Behind Mourepiane will be storage places and possibly the free-port zone authorized in 1938. So far the 1,400 m. of the outer breakwater and the quays of the south dock have been built, while the end of the central mole and one wall of the petroleum basin have been started. The blocks used in the breakwater weigh 350–450 tons. It is intended to provide 13 m. (42·6 ft.) minimum depth alongside all berths. Work was begun in 1937 on improvements at the P. and O. quay at Cap Janet, which lies between the Mirabeau and Président Wilson basins. Accommodation is being provided at the quay for three 200 m. liners, together with a maritime station to facilitate passenger and mail traffic.

The passages connecting the existing basins are being progressively improved. In 1935 the Pinède Pass was provided with a two-arm bascule bridge, with an opening 70 m. (230 ft.) wide and having 12 m. (39·4 ft.) draught. The Abattoir Pass bridge has been removed prior to alteration. At the Joliette Pass the hydraulically worked bridge is to be replaced by an electric bascule bridge, and the pass is to be widened to 40 m. (131 ft.) and deepened to 10 m. (32·8 ft.) (see Plate 46).

In October 1940 the Vichy government announced that works costing 420 million francs were to be started so that in five years the port would be capable of handling all the shipping of the French Empire.



*Trade**Cargo Movements, 1937 (thousands of tons)*

	Foreign trade		Foreign total	Coastwise total	Sea-borne total
	Imports	Exports			
Marseilles	3,677·9	1,954·9	5,632·8	648·5	6,281·3
Bouc	1,887·8	372·9	2,260·7	332·6	2,593·3
La Mède	390·0	145·7	535·7	208·0	743·7
Total	5,955·7	2,473·5	8,429·2	1,189·1	9,618·3

Total foreign trade of Marseilles, Bouc, and La Mède, 1938 (provisional figures): 9,957·3.

The trade of Marseilles proper is less ill-balanced than in many French ports, for in 1937 exports amounted to more than half the weight of imports. The adverse balance is less than that of the neighbouring port of Genoa.

For the purposes of detailed trade returns, Marseilles includes the annexed ports of Bouc-Berre and La Mède (see pp. 198-9). In the trade of the entire group of ports fuels represent more than 50 % of the imports. In the last two decades the oil import has passed the coal import, and is likely to increase fairly steadily in the future as the new refineries on the Etang de Berre expand their output. More than half the petroleum comes from 'Iraq, and more than half the coal from Great Britain. Over a million tons of imports is provided by a great variety of foodstuffs, largely unrefined sugar, fruit, rice and vegetables. The grains are imported mainly from North Africa and Indo-China, the fruit and vegetables from North Africa, and of the sugar, about half is supplied by the French West Indies and Réunion. The exports are largely derived from the industries of the neighbourhood, and include refined sugar, which provided the largest single item of export in 1938, refined petroleum products, refined vegetable oils, chemicals, and soap. The exports, however, include a large variety of manufactured goods together with refined and semi-refined metals derived from more distant hinterlands. These manufactures in 1938 amounted to the considerable total of over 200,000 tons, and the metals and minerals to 158,000 tons, about one-sixth of all the export tonnage, but in export values the manufactures take a very much higher place. In both the import and export trade of Marseilles a considerable weight is provided by postal packages from the liner and mail services to various parts of the French Empire.

Of the weight of imports, 40 % is derived from 'Iraq, Algeria, Great Britain, French West Africa and Indo-China, while these countries take 59 % of the exports. The import of British coal declined from 2,000,000 tons in 1913 to 806,000 in 1932 and to about 500,000 in 1938, largely owing to the decrease in bunker coal. The share of Great Britain in the trade of Marseilles is declining, while that of Germany is increasing. The U.S.A. is losing her dominance in petroleum imports. Marseilles is naturally interested in the trade of North Africa, and this seaboard supplies 17 % of its imports and takes 45 % of its exports. The import of North African cereals, however, has been reduced in recent years by the activities of the National Office of Grain; there is also a tendency for Algerian fruit and early vegetables to be dispatched direct to Atlantic and Channel ports, so that the percentage of trade taken by North Africa decreased during 1933-7 from 58 to 44. The import of ground-nuts from French West Africa is increasing.

The colonies play the principal role in the export trade, taking two-thirds. Of the colonial market, North Africa was responsible for 77 % of the purchases in 1937, of which Algeria took over half. Algeria purchases gasoline, fuel oil, ground-nuts, refined vegetable oil; Tunisia, cement and refined vegetable oil; Morocco, sugar; French West Africa, cement and flour; Indo-China, cotton textiles; Madagascar, Syria and Réunion, flour, etc.; these are the outstanding items in a great variety of commodities exported to the colonies. Of the foreign customers, Germany takes the first place owing to its import of bauxite and is followed by Great Britain (bauxite); Italy (iron and vegetable oil); U.S.A. (potash, tartaric acid); and Spain (food products since the civil war). The many liner services operating from the port facilitate the dispatch of an enormous range of articles in small consignments to many colonial and foreign destinations.

The passenger traffic is considerable, and in recent years the number of passengers has fluctuated between 700,000 and 850,000. Most of the passenger movement is from the Joliette basin to Algeria (350,000 in 1938), and, in decreasing order, Corsica, Tunis, eastern Mediterranean, Morocco, and the Far East, etc. Over half a million people go to North Africa as a whole.

The considerable extensions of the dock system have enabled Marseilles to cope with an increase of traffic of 50 % since 1913: the gross tonnage of shipping using the port then was 21.2, and in 1936 33.6. The total cargo tonnage of Marseilles and its annexes is growing slowly, and the combined total is the largest for any French



port, although the trade of Marseilles itself is smaller than that of Rouen. The combined total for Marseilles is greater than that of its neighbour, Genoa, which amounted to 6·317 million tons in 1936.

*Foreign Sea-borne Trade (in million cargo tons)*

	1937	1938
Marseilles and annexes	8·430	9957·3
Rouen	8·302	7701·6
Havre	5·292	6667·1
Bordeaux and annexes	4·479	4144·1
Dunkirk	4·028	4244·6

If coastwise traffic be added, the trade of Rouen exceeded that of Marseilles in 1937, and if river traffic be added, Rouen handled the greatest aggregate tonnage at French ports. In Europe as a whole, Marseilles has declined relatively to the northern ports. In 1832 it was exceeded in importance only by London and Liverpool, but in 1889 it was passed by Hamburg, in 1893 by Antwerp, and in 1896 by Rotterdam, when it was rivalled also by Newcastle. This relative decline is due to the absence of any great industrial region nearby comparable to those which are served by the northern ports of Europe. It reflected also the loss of the dominant position in mail and passenger traffic once held by Marseilles, for this century has seen the rise as competitors not only of Genoa but of Trieste and Brindisi and even of Salonika. The trade of the port has come to depend more and more upon its own industries, in which it shows a considerable resemblance to Barcelona; of its imports only one-third are dispatched beyond the city and its suburbs. Marseilles has been described as a port which works by itself and for itself.

*Industries*

The industries of Marseilles are varied, and took their origin partly from the products of the surrounding district. Scent and olive oil from the fields and gardens of Provence were the basis of the well-known oil and soap industries which have expanded enormously with imports of oil seeds. Related industries are the production of glycerine and chemicals, in part for government explosive factories. Cork from the Maures and Esterel mountains provides material for cork processing industries. The proximity of limestone quarries and the easy import of coal have made possible the manufacture of cement, while two companies are engaged in exploiting the bauxite deposits not far away. The port traffic is the basis of ship repairing, while there are important marine engineering works which build engines for the

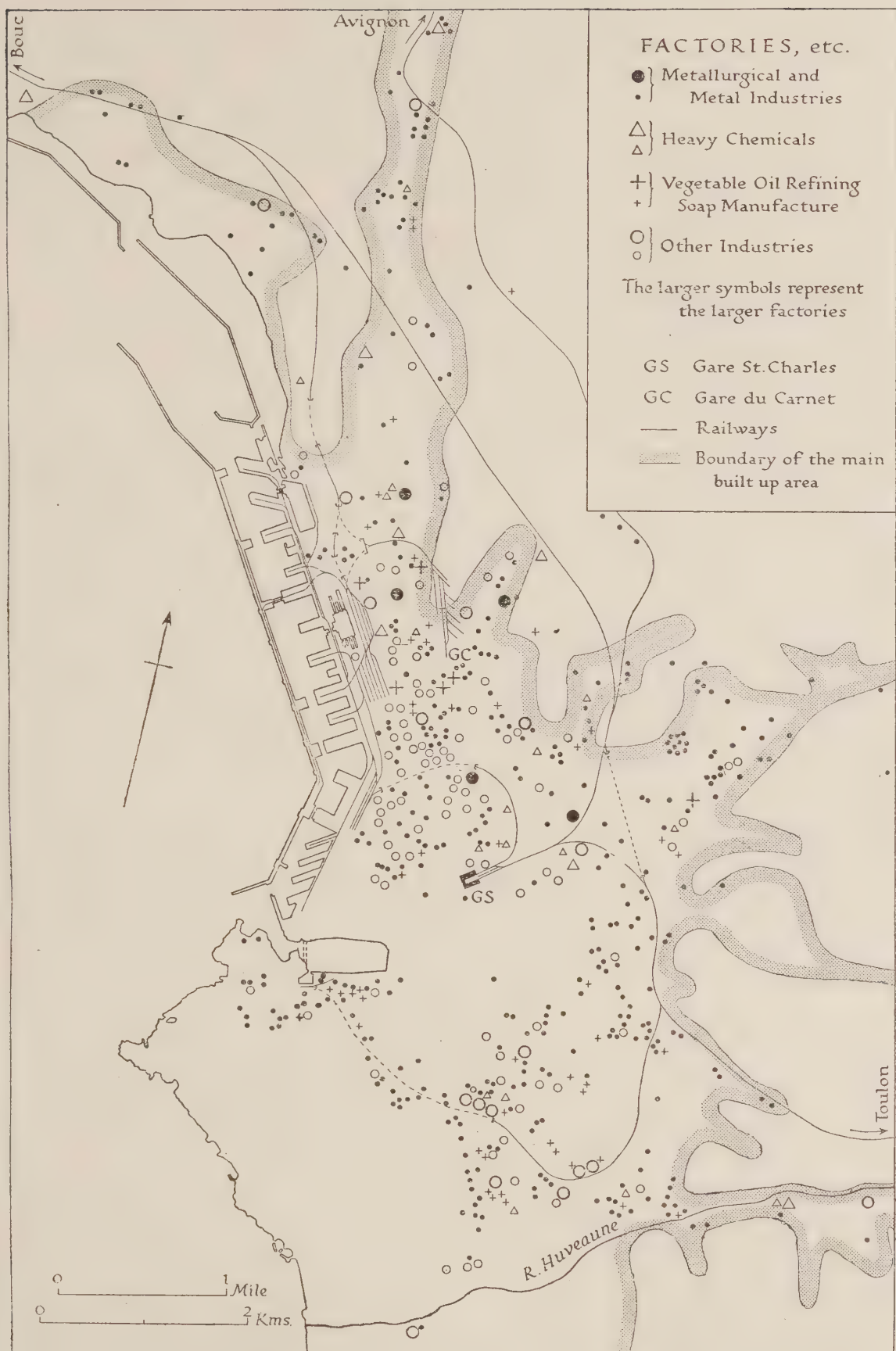


Fig. 50. The industries of Marseilles

The factories have avoided the centre of the city and have spread north and south rather than inland to the eastward. While the many oil and soap factories are roughly equally divided by the centre of the city, most of the larger ones lie in the northern group, near the principal heavy industries.



shipyards of La Ciotat and Port-de-Bouc. There is also a small aircraft factory at Marseilles. There are, finally, the industries characteristic of large ports: the preparation of foodstuffs such as sugar refining and flour milling, saw milling and the refining of metals—industries which work for the large local market as well as for more distant consumers. The greatest development of industry in the past quarter of a century has taken place along the shores of the Etang de Berre.

### *Communications*

The quays are served by 65 km. of railway. The principal station of the port is the Gare d'Arenc behind the Gare Maritime basin. There are two others, the Joliette and Port-Vieux stations, but the Gare d'Arenc is the principal one for handling traffic to and from the quays and for making up trains. A new station, Gare du Carnet, is being constructed behind the Gare d'Arenc; this station will be connected with the docks by two tunnels. The extensive railways serving the docks of the Mirabeau basin will be constricted to a narrow passage at the foot of a hill at Cap Janet before reaching the shunting yards which will be laid out when the basin is completed. There are two town stations, St Charles and Prado, of which the former is much the more important.

Unlike the other great ports of France, Marseilles is cut off from its hinterland by a flat-topped limestone ridge which offers a great obstacle to transport. With the coming of the railway this drawback became a less serious one for mail and passenger traffic, but it remained a handicap for the movement of merchandise, and hence the scheme for a canal connexion to the Rhône was set on foot. *The Marseilles-Rhône Canal*, accommodating 1,000-ton barges, now joins Marseilles to the Rhône. The route lies by way of the Rove tunnel and follows the Etang de Bolmon and the Etang de Caronte to Port-de-Bouc. Traffic can continue thence by the canal to Arles, or cross the Golfe de Fos and travel by the small ship canal to Port-St Louis-du-Rhône. Navigation to St Louis, however, is liable to interruption when the mistral is blowing. The main waterway is at sea-level throughout its length of 80 km., and the only lock is at the westward end. The width is 18.3–24.4 m. (60–80 ft.) and the depth 3 m. (10 ft.) from Marseilles to Port-de-Bouc and 2.4 m. (8 ft.) thence to Arles. The Rove tunnel, which pierces the Chaîne de la Nerthe, is 7.2 km. long and involved the excavation of 2½ million cu.m. of material. From the southern end of the tunnel the barge

route into the Marseilles docks lies behind the breakwaters. The distance of 44 km. from Marseilles to Martigues by sea is shortened by the canal to 25 km. Since 1934 vessels from the Canal du Midi have been using the canal from Arles to Bouc in order to reach Marseilles. Mercantile interests in the port are strongly in favour of the scheme for canalizing the Rhône, for the completion of the work

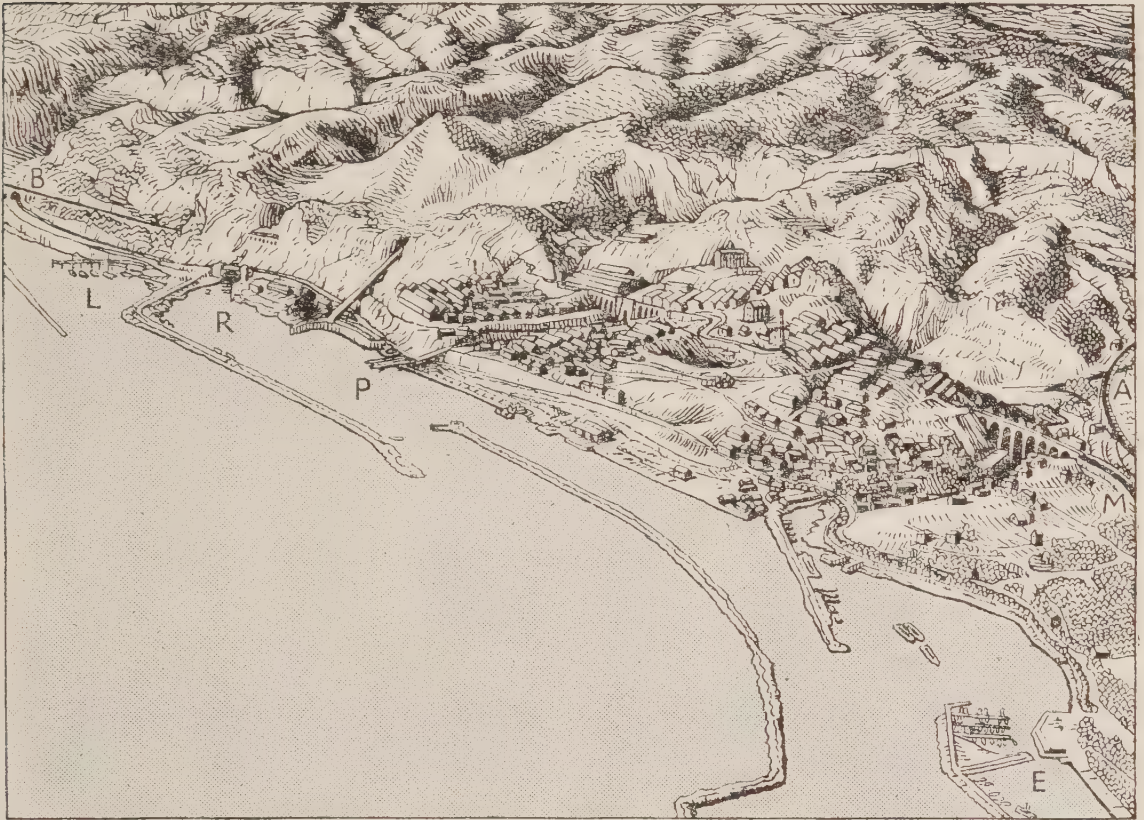


Fig. 51. L'Estaque, Marseilles: the entrance to the Marseilles-Rhône Canal, and the Kuhlmann smelting works

These works treat ores for the recovery of silver, lead, zinc, gold and copper. *A*, railway to Arles; *B*, railway to Port-de-Bouc; *M*, railway to Marseilles; *E*, L'Estaque; *L*, Port de la Lave; *P*, smelter wharves for barges; *R*, mouth of Rove tunnel. The broken nature of the ground here makes extensive tunnelling necessary for the railways. The line to Port-de-Bouc can be seen over the tunnel entrance on a viaduct.

would enable them to compete effectively with the Rhine ports for central European traffic. The distance from Port Said to Strasbourg by Marseilles and the Rhône is 3,850 km., and by Gibraltar and Rotterdam 6,792 km.

The airport of Marseilles is at Marignane, on the eastern side of the Etang de Berre, on the shore of the Etang Vaine. This airport, 20 km. (45 min. journey) north of Marseilles, is equipped for airships, aeroplanes and seaplanes. Created in 1922, it has been controlled



by the Marseilles Chamber of Commerce since 1934. In 1938 it handled 400 tons of goods and 34,000 passengers.

It need hardly be said that the sea connexions of Marseilles are world-wide, although the Mediterranean, African and Eastern trades are dominant. Sixty-six shipping lines serve the port.

### SUBSIDIARY PORTS OF MARSEILLES

#### *Port-de-Bouc*

This port is entered from the eastern side of the Golfe de Fos through a passage about 180 m. wide, between a mole extending southward and eastward of Pointe de la Lèque, and a small peninsula opposite. South-westerly winds cause the heaviest sea at the entrance,

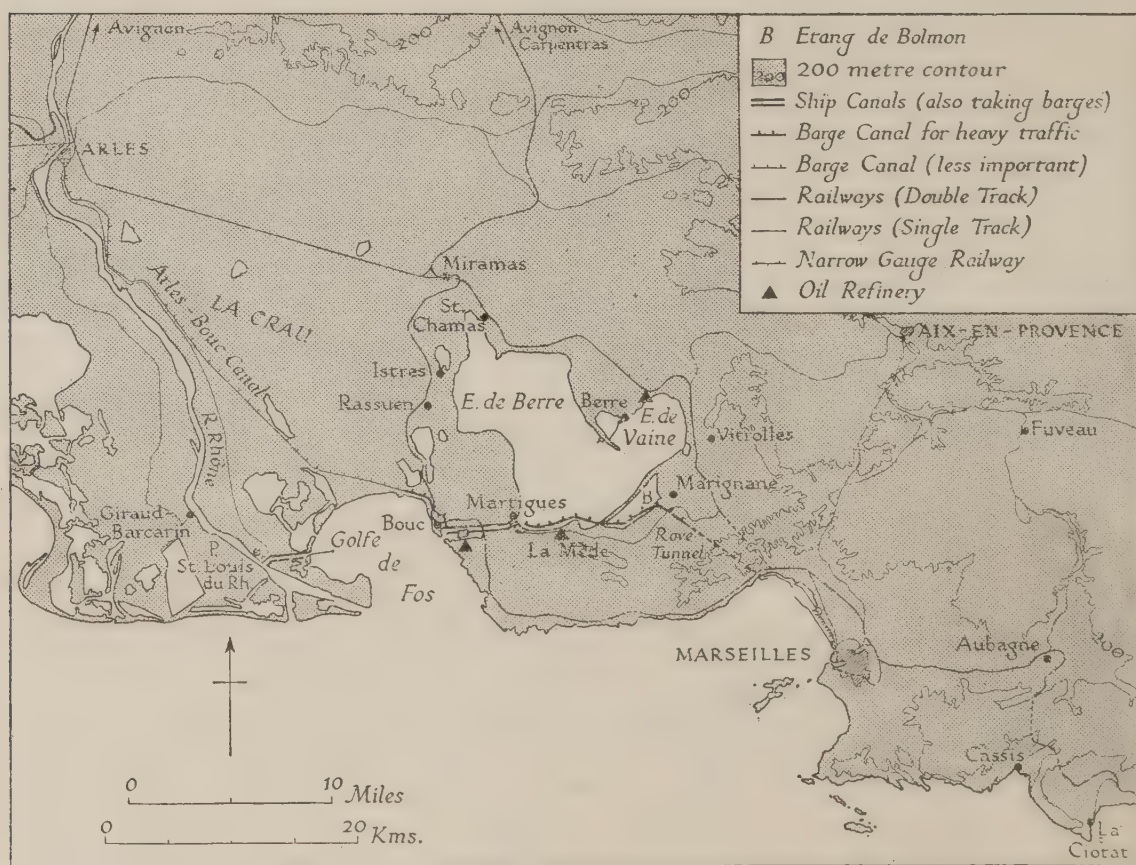


Fig. 52. Marseilles, the Rhône delta and the Etang de Berre

and create an ingoing current which increases the difficulty of entrance, while with a high sea access is impossible. In 1939 the maximum draught permitted was 8.0 m. (26.25 ft.), although dredging was in hand to allow a draught of 9.0 m. (29.5 ft.). The width of the entrance channel is 137 m. (450 ft.). The south-eastern part of



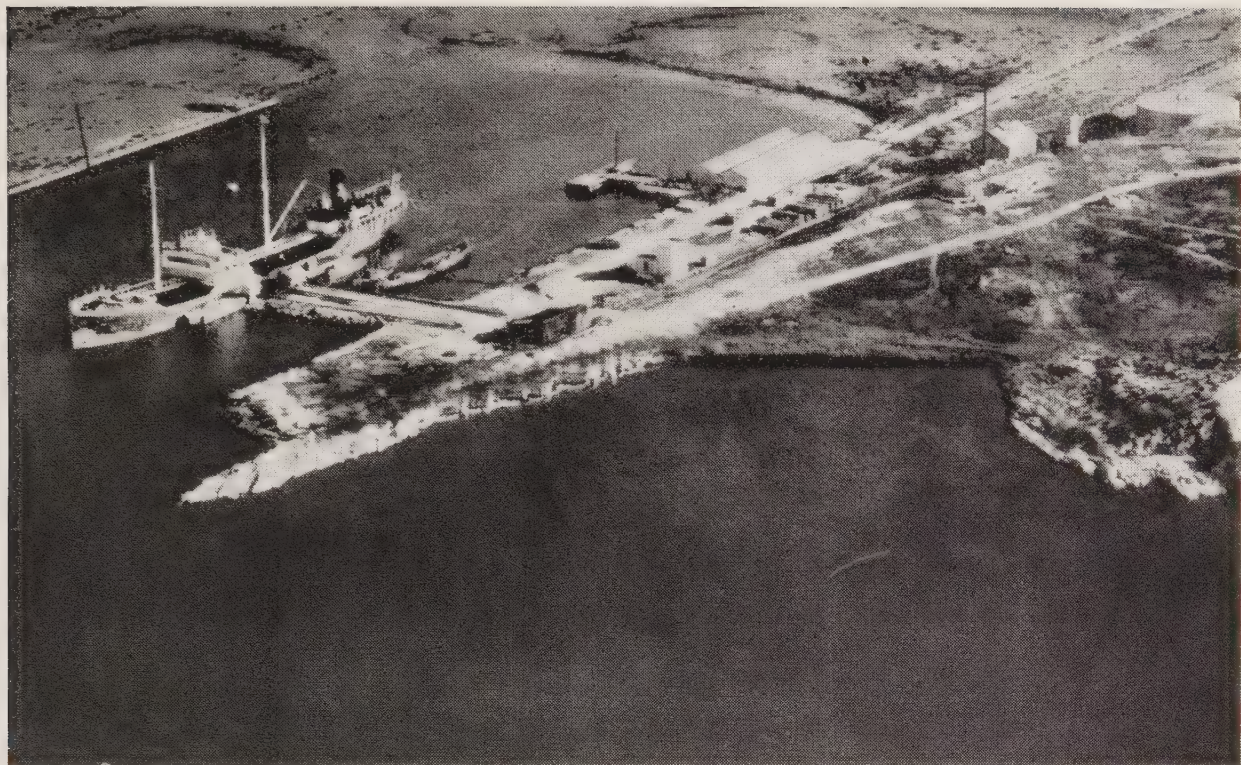


Plate 47. Lavera petroleum port (looking south-east)  
 Pipe-lines lead to the refinery which lies to the right of the photograph.



Plate 48. Lavera Oil Refinery (looking north across the Etang de Caronte)

The main part of the refinery lies to the left; to the right is the works siding and the railway from Avignon and Arles to Marseilles via Port-de-Bouc. The swing bridge of the Caronte viaduct over the *Canal Maritime de Caronte* can be seen closed. The quays of the canal lie east and west of the bridge on the farther side.



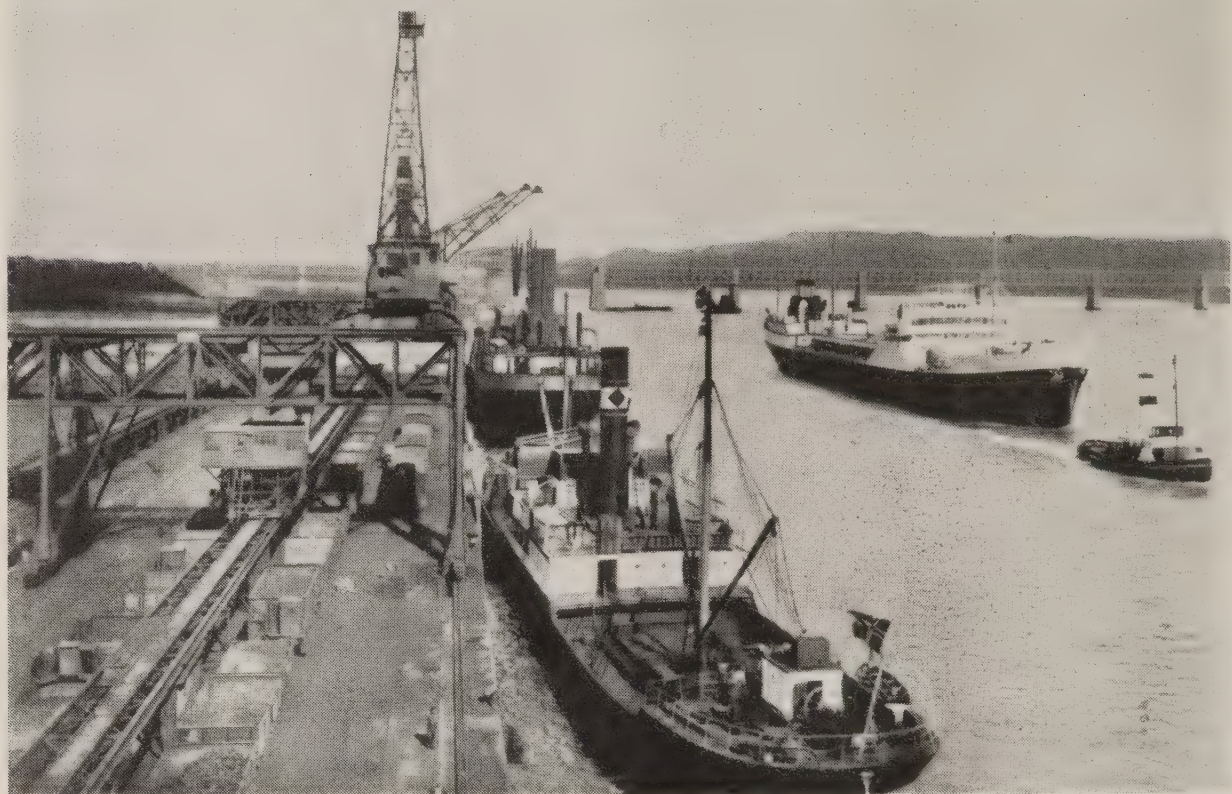


Plate 49. Etang de Caronte (looking east towards the Etang de Berre)

The freighters are alongside the quay of the *Etablissements Maritimes de Caronte*, the principal quay between Port-de-Bouc and Martigues. In the distance the swing bridge of the Caronte viaduct can be seen closing after the passage of the outward-bound tanker.



Plate 50. La Mède: the barge dock (looking north-east towards Berre)

The illustration shows the barge dock opening from the Marseilles-Rhône Canal; the tanker mooring berth lies to the left, outside in the Etang de Berre, and La Mède refinery to the south, on the mainland.

the harbour, except the dredged channel and Port de Lavera, has depths of only 0·9–2·1 m. (3–7 ft.).

The dimensions of the older basins at Port-de-Bouc are as follows:

	Area ha.	Length m.	Width m.	Entrance width		Depth		Length quayage m.	Depth alongside	
				m.	ft.	m.	ft.		m.	ft.
Bassin du Port	11	579	200	160	525	9	29·5	—	—	—
Bassin Aubran	6	579	100	19·8	65	3·9–5·5	13–18	300	2·9–3·8	9·75–12·75

The entrance to the canal to Arles, leading to the Rhône, is through a basin 320 m. long, and with 580 m. of quay, in the northern end of the harbour:

	Width		Depth	
	m.	ft.	m.	ft.
Entrance	60	197	2·9	9·5
Canal	24	78·7	2·0	6·5

The quays most used by sea-going ships extend along the ship canal in the Etang de Caronte (see Plate 49).

Quay	Length m.	No. of berths	Draught	
			m.	ft.
De la Lègue	200	2	8	26·2
Kuhlmann	120	1	8	26·2
Établissements Marit. de Caronte	650	5	9	29·5
Vermineck	135	1	9	29·5
Lavéra, petroleum berth	60	1	8·5	27·9

There are fourteen cranes in the port, and ten sets of specialized loading gear.

The petroleum harbour, Port de Lavera, lies in the south-eastern corner, and is approached by a channel 59·4 m. (195 ft.) wide on the surface and 38·4 m. (126 ft.) wide on the bottom, with a depth of 8·9 m. (29 ft.). Access through this channel is not easy: large vessels are towed in stern first, and manœuvring is difficult with the wind or current across the entrance to the channel, as the current sometimes attains 4 knots. The basin is little wider than the channel; a wharf allows tankers to lie alongside (see Plate 47).



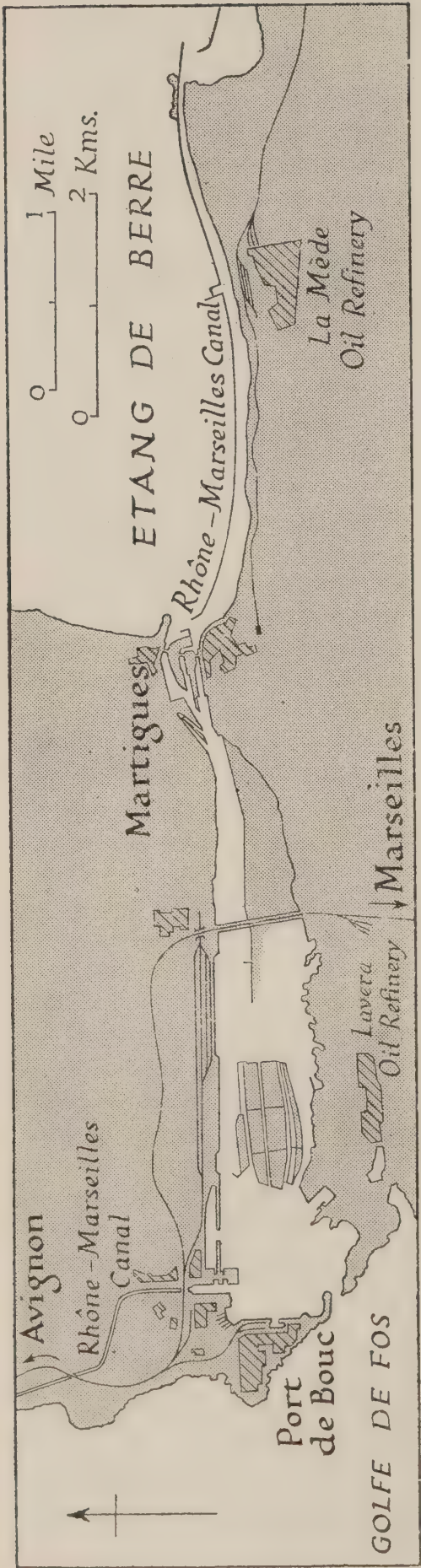


Fig. 53. Port-de-Bouc and the entrance to the Etang de Berre

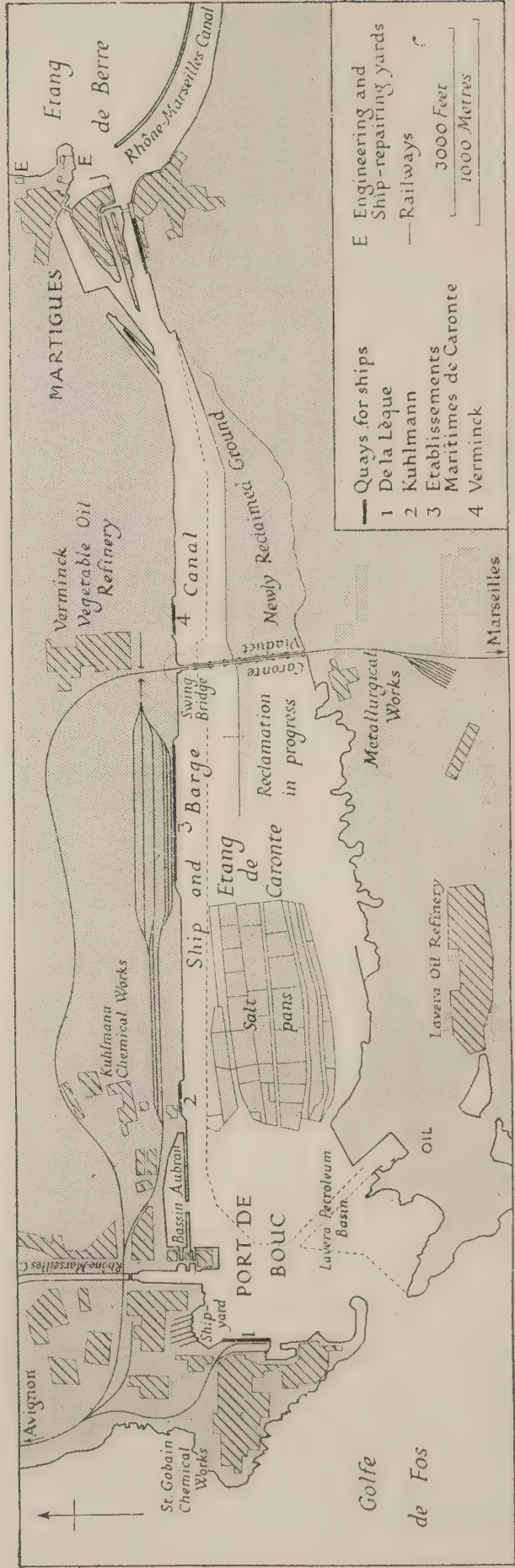


Fig. 54. Port-de-Bouc and the Canal Maritime de Caronte

The Lavera oil refinery extends over most of the ground between the Lavera petroleum basin and the railway south of the viaduct; the railway siding serves the refinery. One of the two small shipyards at Martigues specializes in ship-breaking.

From Port-de-Bouc, along the northern shore of the narrow Etang de Caronte, the ship canal leads to Martigues, where the Etang widens into the Etang de Berre. This canal is also a section of the Marseilles-Rhône canal. It had a depth of 9.0 m. (29.5 ft.) in 1939, but the maximum draught permitted was 8.0 m. (26.2 ft.); the bottom width varies from 30.2 to 50.3 m. (99 to 165 ft.), though it is proposed to

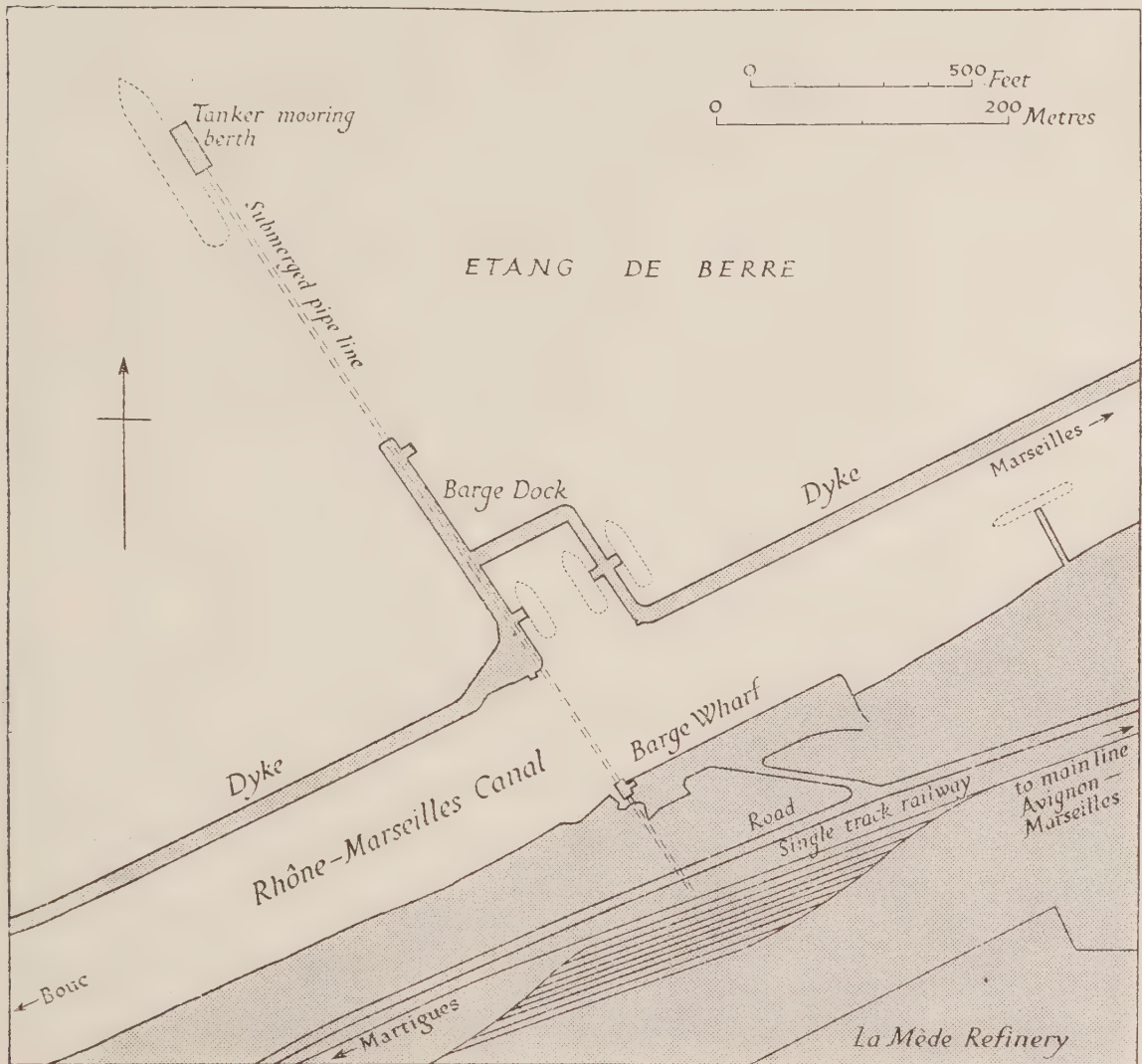


Fig. 55. Tanker berth, La Mède, on the south shore of the Etang de Berre

make the maximum width constant all the way. The northern side is quayed for much of its length of about 3,600 m. with depths of 9.0 m. (29.5 ft.). Half-way along the canal is a swinging area, dredged to 9.0 m. (29.5 ft.) and about 400 m. long and 110-160 m. wide. The Caronte viaduct, carrying the P.L.M. railway to Marseilles, crosses the Etang, and gives an effective headway of 21.0 m. (69 ft.), while the northern span is a swing bridge.



*Martigues* is little more than a transit point for traffic proceeding from Port-de-Bouc into the Etang de Berre; the entry channel has depths of 9.0 m. (29.5 ft.) and is crossed by a swing bridge. The current running in and out of Etang de Berre at times reaches a rate of 3 knots. There is only one quay, 250 m. long.

The Etang de Berre is a considerable body of water covering 15,600 ha. In 1932 there were depths of 7.3–10.0 m. (24–33 ft.) all over the central part, though the deposition of silt proceeds rapidly, resulting in a decrease of depth of about 0.9 m. (3 ft.) in 60 years. The channel from Martigues extends about 2,400 m. into the lagoon, with a depth of 8.8 m. (29 ft.), and is 30.5 m. (100 ft.) wide on the bottom. In 1936 it was planned to widen the channel and to deepen it to 9.0 m. (29.5 ft.). From Martigues the Marseilles-Rhône canal branches off to the south-east and follows the southern shore of the lagoon and of an extension, the Etang de Bolmon, until it enters the Rove tunnel near Marignane. On the south side of the Etang, where the Rhône-Marseilles Canal is close to the shore, there is a petroleum discharging point at *La Mède*, with one berth, by anchoring, on a draught of 8.0 m. (26.2 ft.). The mooring and handling of vessels at this berth is complicated when the *mistral* (a northerly wind) is blowing strongly (see Plate 50).

On the eastern side of the Etang, at *Pointe de Berre*, is a new petroleum harbour, with one berth, by anchoring, on a draught of 8.0 m. (26.2 ft.), protected from the north-west by a small mole. A jetty for oil discharging accommodates only the pipe-lines, and tankers have to moor and anchor at least 6 m. away. Ships of 12,000 tons can be accommodated; for a large vessel to cross the Etang and moor at this port two tugs are required. The older town of Port de Berre lies inside the Etang de Vaine, an extension of the Etang de Berre, and is accessible only to boats drawing less than 2.6 m. (8.5 ft.).

### *History*

For long this region of extensive inland bodies of water had remained almost unutilized except for some fishing and the long-established industry of salt evaporation. At the end of the nineteenth century the absence of development there was described by one authority as an economic scandal. The great obstacles at that time were the silted up entrance to the Etang de Caronte, by way of the Golfe de Fos, and the ability of Marseilles to deal adequately with

the commodities then entering into trade. With the war of 1914-18, however, the region was found to possess certain advantages. Its location and nature afforded security; its wide expanse of flat shore or easily reclaimed shallows provided ample sites for industrial undertakings; progress in dredging permitted the opening of channels for navigation. The increase in the petroleum import then and in later years demanded extensive ground for the establishment of refineries. A number of chemical and explosive factories were set up during the

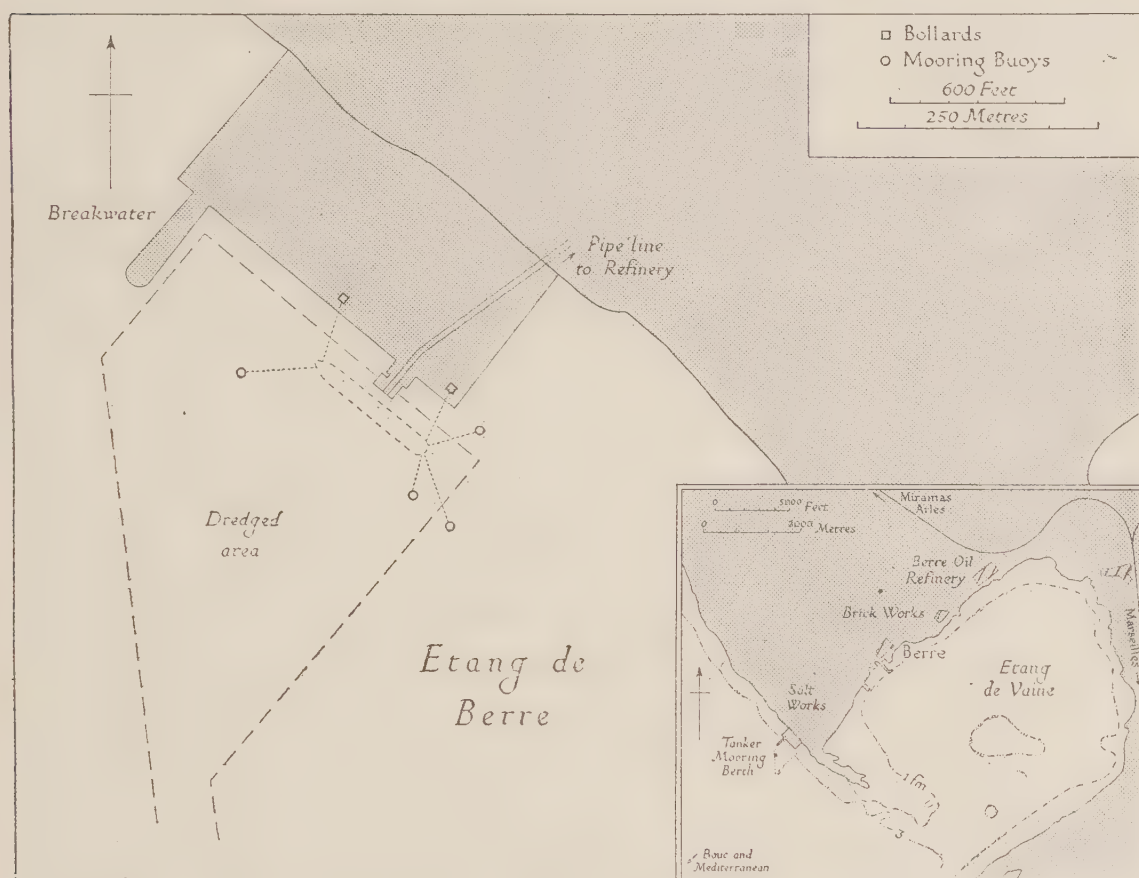


Fig. 56. Tanker berth, Berre, on the east shore of the Etang de Berre

war; since then there has been considerable expansion of petroleum refining, while the flat ground has also provided favourable sites for aerodromes, many being concentrated here. In 1911 these ports were placed under the jurisdiction of Marseilles, and formed a system of port facilities complementary to those of the older port, for the site of Marseilles is not well adapted to the expansion of industries requiring much ground.

The completion in 1927 of the Rove tunnel on the Marseilles-Rhône Canal was an important further stage in the progress of the ancilliary ports. While concerned mainly with through traffic from



Marseilles to the Rhône Valley, it has greatly improved water transport for heavy goods between the main port and its subsidiaries, and enabled cargo handling and industry in the different locations to be integrated.

Many development schemes are in hand for the improvement of this group of ports, for there are 40 km. of quay or wharf sites available, half as long again as at Marseilles. At Port-de-Bouc the Quai de la Lègue is to be lengthened, and the depth of the access channel is to be increased in conformity with the general plan to improve the navigability of the Etang de Caronte. The Lavera petroleum basin is to be transformed into a public basin, 10 ha. in area, with six pipelines, a large repair dock, etc. In the Etang de Caronte the ship channel is being dredged to 9.7 m. (32 ft.), and part of the southern shore is being reclaimed for industrial sites. The greatest development will take place along the shores of the Etang de Berre. Apart from ground on the shores, over 1,800 ha., five or six times the amount of space available at Marseilles, can be provided by reclamation of shallow water. Five areas are to be dealt with. The northern shore, from Baie de St Chamas to Arc, is steep, but the shallow water will be reclaimed for railway lines and factory sites. Along the eastern shore between Arc and Berre extensive quays are planned, both for the tankers already using the discharging wharves and for general traffic, together with protective breakwaters. In the south-east it is proposed to fill in the Etang de Bolmon to provide sites for factories and railways. Along the southern shore a small amount of filling in of the rocky portions is contemplated, together with the construction of a breakwater for the protection of shipping. Developments like the wharves and refinery at La Mède are likely to take place in the future. Along the western shore reclamation is planned for all the shallow parts out to a depth of 9.1 m. (30 ft.); railway communication is assured with both Istres and Martigues.

### *Trade*

The trade of the annexed ports has shown regular progress since 1913. In 1913 they handled 90,000 tons of cargo; in 1937, 2,796,000; and in 1938, 3,486,000. The tonnage handled in 1932 amounted to 18 % of the total Marseilles traffic and in 1938 to 35 %. There is no passenger business. The expansion of the trade of Marseilles as a whole since 1918 has been due largely to the increasing tonnages of petroleum handled at these annexed ports. The imports of these annexed ports amount to about three times the tonnage of the exports;

both consist principally of fuels. The tonnages handled in 1938 are fairly typical:

*Thousands of tons*

Imports, 2,500

Fuels:	
Crude oil	921
Petroleum products	480
Coal	870
Coke	40
	<hr/> 2,311

Exports, 980

Fuels:	
Petroleum products	710
Coal	100
	<hr/> 810
Bauxite	100
Lime and cement	20
Chemicals	20

(The fuel imports of Marseilles proper were 788,000 tons.) Other imports consist mainly of sulphur and pyrites, phosphates and other minerals, and oil seeds.

The petroleum traffic grew to such proportions after French interests secured a quarter share in the control of the Mosul supplies; it was encouraged by the legislation of 1928.

*Traffic, 1938 (thousands of tons)*

	Bouc-Martigues		Etang de Berre	
	Outwards	Inwards	Outwards	Inwards
Shipping	978	981	670	663
Cargo	388	1,613	485	958

Including cargo moving inland.

### *Industries*

At a number of points around the lagoon there are salt works, modernized survivals of a very ancient industry. At Port-de-Bouc the outstanding industry to-day is shipbuilding, carried on by the *Chantiers et Ateliers de Provence*; the yards contain six slips over 125 m. long, the longest being 150 m. in length. It is believed that the company has also undertaken the manufacture of aircraft. At the Lavera petroleum dock the refinery, which has an annual capacity of 500,000 tons, is one of the greatest producers of butane in France. Two chemical works produce chemicals and superphosphates, one having an annual production for the latter of 60,000 tons; fat products are also treated. Part of one of these factories has been taken over by a Belgian zinc refining concern. At Caronte, midway between Port de Bouc and Martigues, lies an oil-crushing plant, the capacity of which may be judged from the fact that 1,000 tons of oil seed per day can be discharged on to the quay. Martigues itself has no large



industrial undertaking, but at La Mède, to the east, is a new petroleum refinery which has a capacity of 1,200,000 tons annually (see Plate 48).

On the eastern side of the lagoon, the chief industrial plant is the oil refinery at Berre, with an annual capacity of 600,000 tons. At Berre itself are salt, chemical and cement works. On the northern shore there is a very large government powder factory at St Chamas, while at Rassuen near Istres there is a large plant manufacturing heavy chemicals and fertilizers (see Plate 51).

## TOULON

(See Figs. 57, 58; Plates 53, 54)

### *General Description*

Toulon (pop. 150,000) is the principal French naval base on the Mediterranean. It has developed some importance as a commercial port, however, and nearby are important shipbuilding yards.

Currents along the coast are very weak and irregular, generally setting westward and attaining their greatest speed near the shore. The splendid natural harbour, containing both outer and inner roadsteads, was formed by the submergence of two east-west valleys. The outer roadstead is separated from the Mediterranean by the Cépet peninsula, which lies east and west, parallel to the coast. This peninsula is attached to the mainland westward by a sandy spit. The entrance is about 6 km. wide, extending from Cap Cépet to Pointe Carqueiranne. The western part of the Grande Rade is limited by Grande Jetée, running southwards from the mainland and 1,250 m. in length. The inner roadstead, which is sheltered from easterly winds by the jetty, consists of several anchorages: Baie du Lazaret to the south, Rade d'Eguillette and Baie de la Seyne to the west, as well as the Petite Rade proper; Grande Passe is the principal entrance. In the eastern parts of this roadstead there is a least depth of 9·4 m. (31 ft.) to within 275 m. of the shore, but the western parts are shallower. A channel with a least depth of 12·2 m. (40 ft.) has been dredged through the Petite Rade up to the entrance of the dry docks on the southern side of Darse Neuve. The Rade d'Eguillette has depths of 10·1–18·3 m. (33–60 ft.); in Baie de la Seyne a channel dredged to a least depth of 9·0 m. (28·5 ft.) leads to the shipyard on the south of the bay, while from the inner end of this channel another channel, with a depth of 4·6 m. (15 ft.), leads to the small harbour of La Seyne.



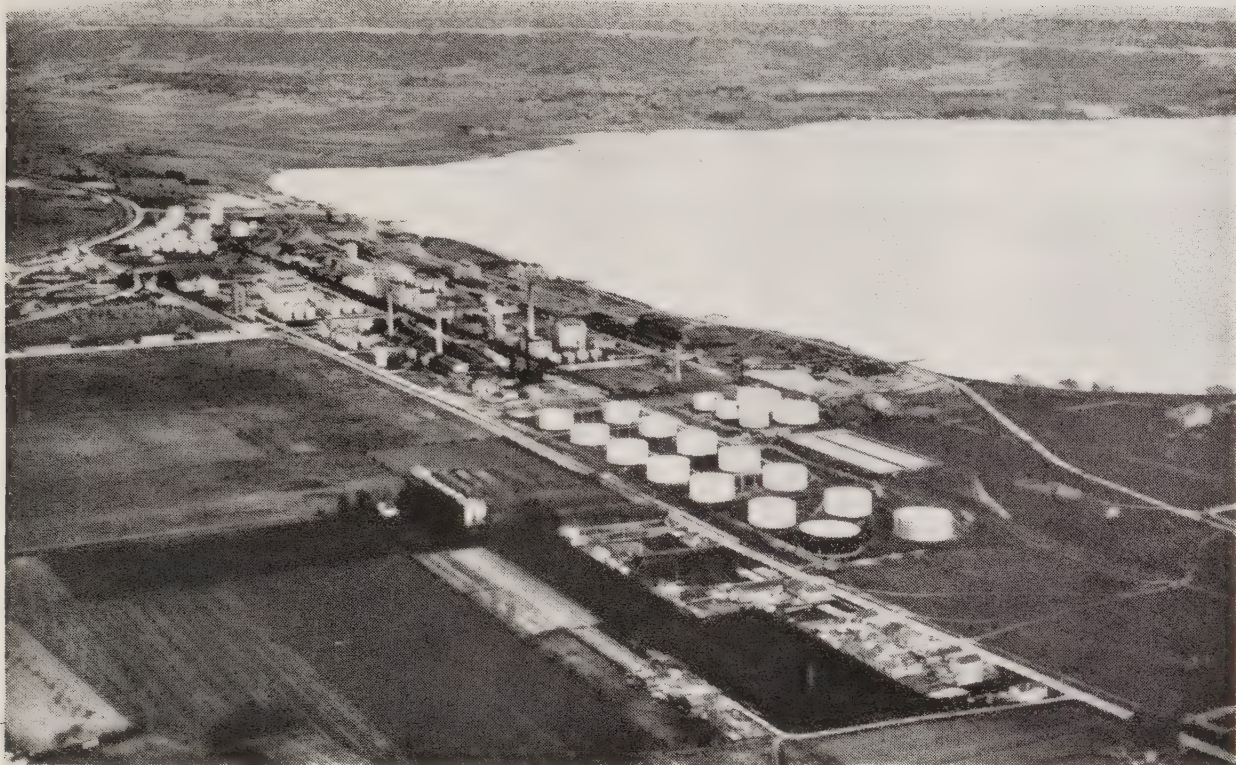


Plate 51. St Gobain Refinery, Berre (looking north-east)

The refinery stands on the shores of the Etang de Vaine and is connected by a 4 km. pipe-line with the tanker mooring berth on the Etang de Berre.



Plate 52. La Ciotat: the shipyard

The illustration shows the launching in 1939 of the fast motor cargo ship *Calédonien*, 9000 tons displacement, from No. 1 slip, at the yards of the *Société Provençale de Constructions Navales*, for *Cie Générale Transatlantique*.



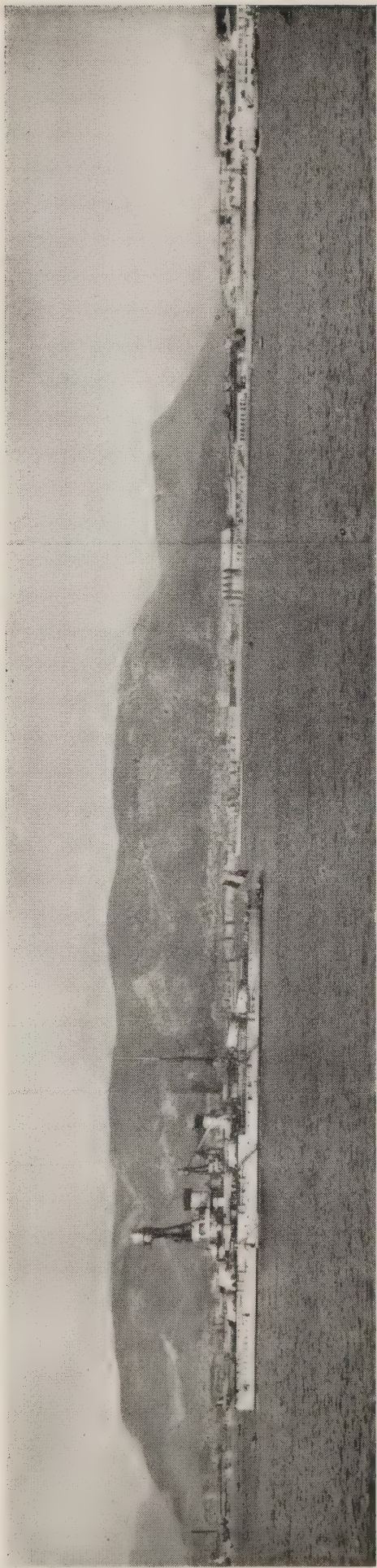


Plate 53. Toulon: panoramic view from the southern side of the Petite Rade

The direction of the view is from northwards on the left round to eastwards on the right. In the distance lies the high limestone mass of Mont Faron. Along the water-front the Mourillon naval establishment is seen to the right and the commercial port in the centre. The basins of the main naval port are hidden by the warship; on the left is the coaling depot, while the tall chimney marks the entrance to the Missiesy Basin.



Plate 54. Toulon: the commercial port (looking south-west across the Darse Nord du Mourillon)  
In the centre is the Quai du Nouveau Bassin shortly after its construction; to the left, outside the Darse Nord du Mourillon, are submarine and destroyer building slips.



### Detailed Description

Toulon harbour is divided into the naval base and the commercial harbour, although in the naval port the Darse Vieille is available for the use of merchant vessels. The naval port comprises the Darse de Missiessy, Darse de Castigneau, Darse Neuve (or Vauban) and Darse Vieille on the northern side of the Petite Rade, and the Darse de Mourillon on the eastern side.

	Depths in naval port		Date of information
	m.	ft.	
Darse de Missiessy	7·3-11·9	24-39	1932
Darse de Castigneau	10·1	33	1932
Darse Neuve (except in the north-east)	10·1-12·8	33-42	1934
Darse Vieille (except in the east)	4·0-9·1	13-30	1932

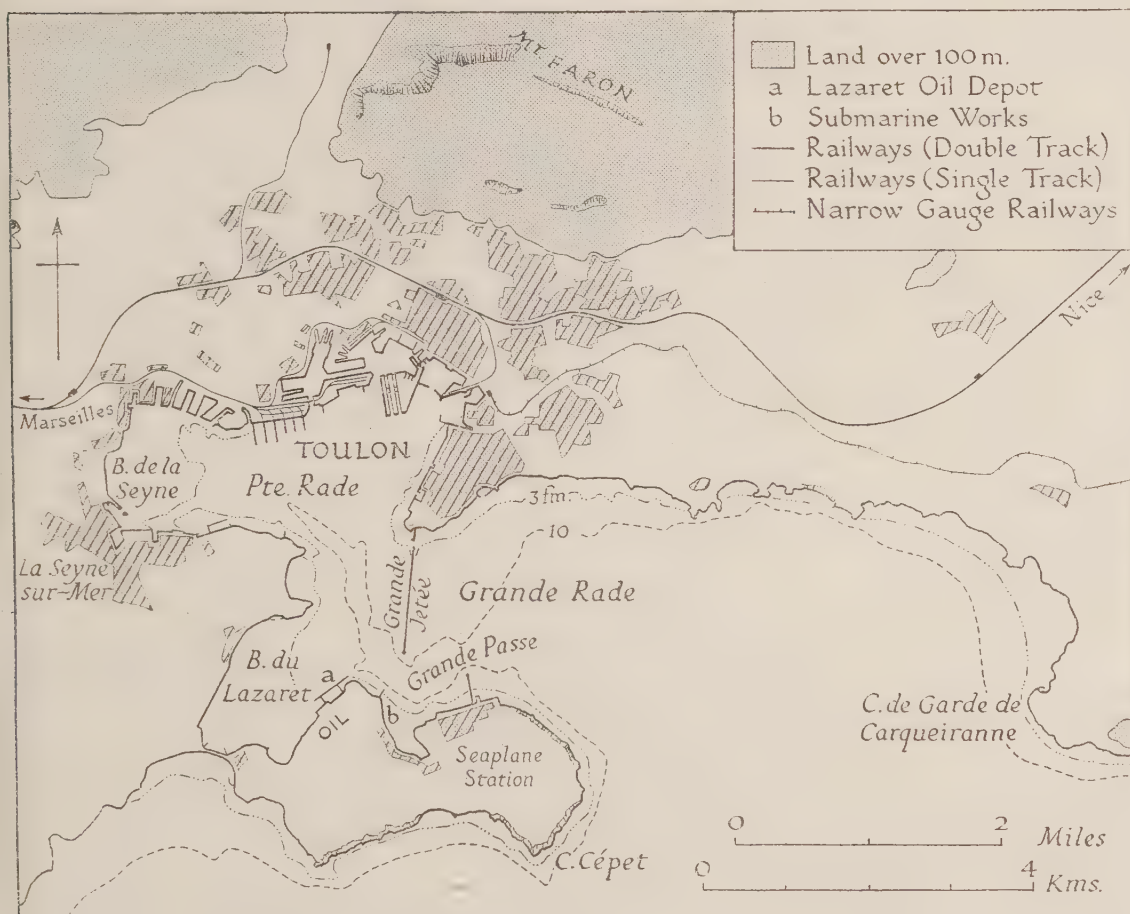


Fig. 57. Toulon and the Grande Rade. (For detailed plan see Fig. 58)

Extending southwards from the wharf close to and west of the entrance to Darse de Missiessy is Port Lagoubbran, consisting of six parallel jetties which are connected with the railway system; two



smaller jetties extend from the coal depot, which lies east of the entrance to the dock.

Various arsenals, workshops and barracks lie around these basins, and partly shut off the town from the water front. To the west, on the north shore of Baie de la Seyne, are the Milhaud magazines, built around three small basins, and behind are the Lagoubran magazines. In the extreme west lies the pyrotechnic establishment. On the east side of the Rade, on the shore of the Mourillon peninsula, are several more sections of the naval base: a submarine station in the Darse de Mourillon, opening off the commercial port, and farther south are building yards for submarines and destroyers. On the south side of the roadstead are the oil tanks and wharves of the Lazaret depot; nearby are the Schneider submarine works; on the shore of the Grande Rade, just inside the entrance to the south, is an extensive seaplane station.

The commercial port can accommodate vessels up to a length of 230 m. (754·6 ft.); the maximum draught permissible is 8·0 m. (26·25 ft.), though in the greater part it is no more than 6·5 m. (21·3 ft.):

Basin	No. of berths	Draught		Length of quay available to sea-going ships m.	Area ha.	Entrance width	
		m.	ft.			m.	ft.
Nouveau Bassin: Quai	2	8·0	26·25	230	3·0	70	230
Port de la Rode:					3·25	40	131
Quai Sud	1	6·5	21·3	100	—	—	—
Quai du Vin	1	6·5	21·3	150	—	—	—
Quai de la Douane	1	6·2	20·5	140	—	—	—
Quai du Carénage	1	4·0	13·0	80	—	—	—
Darse Vieille	—	4·5	14·8	—	3·5	40	131

The Darse Vieille has 460 m. of commercial quays along the north side, used by coasting steamers. The Nouveau Bassin, to the north of the Darse de Mourillon, was formerly greater in extent, having been reduced in area by the construction of a quay some years ago to handle the export of bauxite. The Port de la Rode is the centre of the general trade of the port. The western quay of this basin, together with the quay of the Nouveau Bassin, have a rail connexion with the main P.L.M. line (see Plate 54).

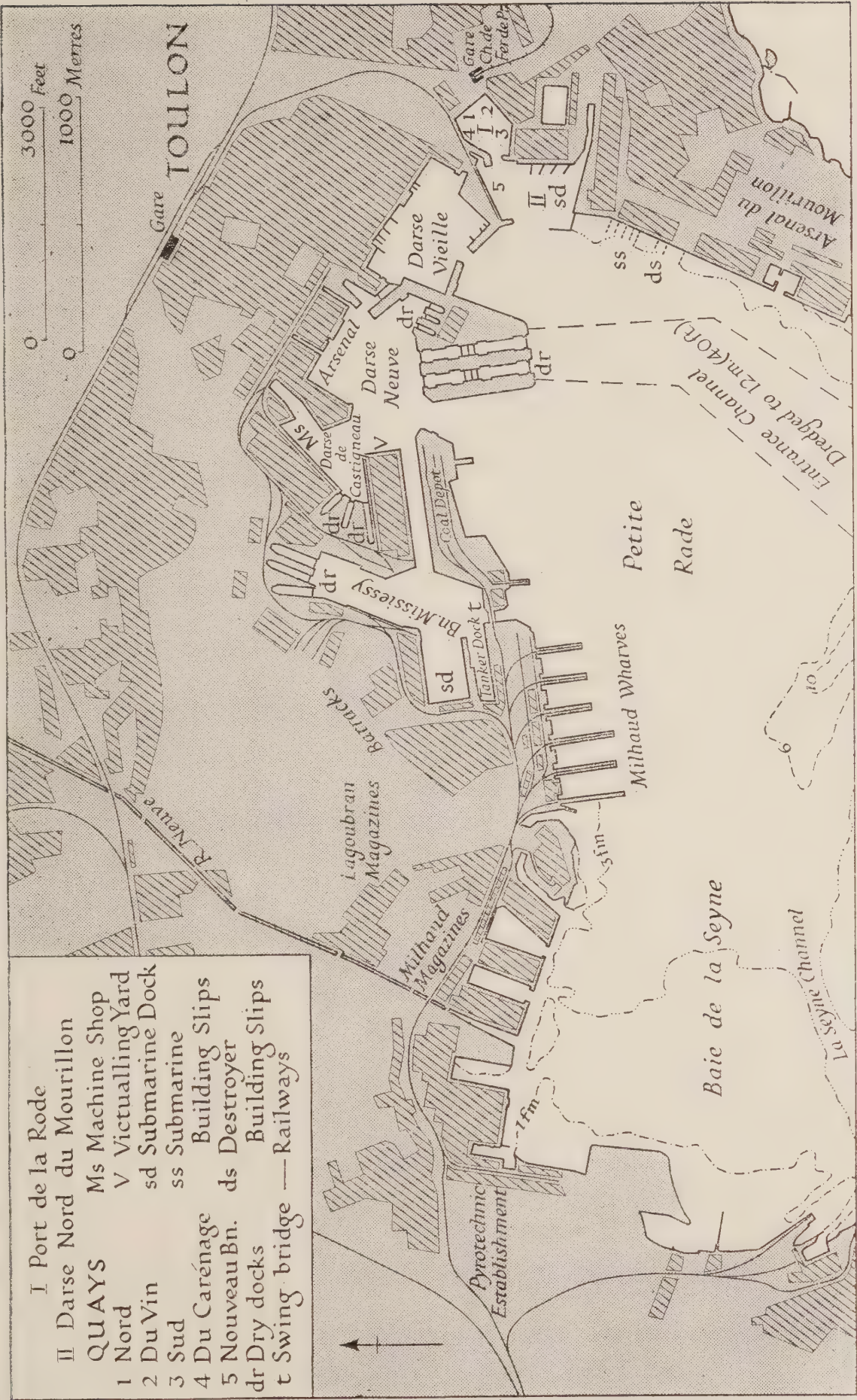


Fig. 58. Toulon



*Port Facilities*

There are ten cranes of a capacity under 10 tons and one 12-ton electric crane. The port is well equipped for repairs, in that across the inner roadstead lies the extensive shipyards of La Seyne. There are several tugs. The naval port contains thirteen dry docks. Nine of these are of the usual type, and the two largest have an extreme length of 200 m. (659 ft.), an entrance width of 30.3 m. (99.6 ft.), and a depth on the sill of 9.3 m. (30.5 ft.). The four other dry docks are two large docks, each of which can be entered from either end and which can be divided internally by intermediate gates. Their extreme lengths are 416.5 m. (1,366 ft.) and 402 m. (1,318 ft.) respectively, and the widths are 40.6 m. (133.3 ft.) and 35.9 m. (118 ft.); the depth on sill is 12.0 m. (39.3 ft.).

*History*

For many centuries Toulon suffered from invasion, and from 718 to 1197 it suffered repeated ravages by the Saracen pirates. In the later Middle Ages it enjoyed some prosperity and developed a strong civic independence, entering into alliances with neighbouring cities like Arles and Marseilles. Toulon, with the rest of Provence, was ruled by French princes after 1259, and in 1481 was finally brought within the kingdom of France. Later kings improved the fortifications, and in the seventeenth century Henry IV founded the arsenal and constructed the first dock. Early in the reign of Louis XIV it was from Toulon that the fleets under Vivonne and Duquesne fought the Dutch in 1672. Vauban carried out improvements and built a second dock. In 1707, during the War of the Spanish Succession, the town was unsuccessfully besieged by the allied powers of England, Holland and Savoy, with a force of thirty-one English and fifteen Dutch ships of the line and an army of some 30,000 Imperial and Savoyard troops. The attempt was not, however, wholly without results, for the French, seeing that their great ships were in danger of falling into the hands of the allies, sank them in the harbour, and when they were raised after the departure of the invaders none were fit for service. During the War of the Austrian Succession a fleet action took place off Toulon in 1744, when an English force engaged, without achieving a decisive result, a combined French and Spanish force. During the Revolutionary Wars English and Spanish fleets cruised off Toulon to contain the French fleet. The inhabitants were mainly opposed to the Jacobins, and handed the town over to the English. In 1793 Lord Hood, with an allied English and Spanish

fleet, occupied the harbour, but with the coming of Bonaparte the allied fleet was forced to leave after having incompletely destroyed the men-of-war that could not be taken away. Soon after, Toulon became the headquarters of Napoleon's Egyptian expedition, and from this harbour Villeneuve sailed for his voyage to the West Indies which was to make the great combination with other fleets and secure the command of the Channel for Napoleon's army for the invasion of England. It was the headquarters for the expeditions against Algiers in 1830. Considerable developments of the naval base took place under Napoleon III.

The commercial activity of the port has grown to some extent with the expansion of the town, and in 1920 the Chamber of Commerce began to improve the facilities so as to permit the export of bauxite. Dredging was carried out and a quay extended to the south-west from La Rode basin, providing 230 m. of effective new berthing in front of the old dock and behind the north Mourillon naval dock. The fortifications of the town were demolished in 1925-30 and boulevards laid out on the sites.

### *Trade*

#### *Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	11.4
Exports	182.5
Total	193.9
Coastwise trade (total)	20.2
Total sea-borne trade	214.1
Total foreign trade 1938 (provisional figures)	261.1

The trade of Toulon is small. The import trade consists chiefly of coal, wine and timber. Successful efforts have been made to develop the export of bauxite, of which Brignoles, 55 km. inland by rail, is the centre of production. As a result, in recent years Toulon has experienced a heavy export surplus. There is a passenger traffic of some dimensions, mainly to Corsica, involving 20,000 passengers annually, and English liners call regularly.

### *Industries*

The industries of Toulon are concerned mainly with fleet maintenance and munition production. Apart from repair work the naval yards build submarines and destroyers, and there are several plants which manufacture mines, torpedoes and explosives. Commercial



undertakings include a cable works and the shipyard of *Forges et Chantiers de la Méditerranée* at La Seyne. This yard possesses three large slips, up to 220 m., and three smaller slips of 123 m. Large vessels can be constructed, and the yard often works for naval orders.

### *Communications*

Lying in a depression backed by limestone hills, Toulon is not well placed for communications. The main line from Marseilles to the Italian frontier passes through the town, but there is little rail connexion with the interior. From 1933 the P.L.M. company carried out extensions of its line down to the port so as to serve coastal towns between Toulon and St Raphael.

It is not likely that Toulon will experience much expansion as a commercial port. It lies too near to Marseilles to be able to capture any appreciable traffic from south-eastern France, and the mountains of Provence which lie behind it restrict the hinterland.

## NICE AND THE RADE DE VILLEFRANCHE

(See Figs. 59, 60; Plates 55, 56, 57)

### NICE

#### *General Description*

Nice (pop. 242,000) is the most easterly French Mediterranean port of any considerable size, and though of only secondary importance its trade is growing. The town lies at the mouth of the river Paillon and extends to the seaward slopes of the Maritime Alps, but the port is situated 1 km. to the east of the river, and thus does not suffer from the deposition of sediment carried westwards by the longshore drift.

The tidal range is only about 0.3 m., but within the harbour there is a perceptible variation of the water level through the influence of the winds and pressure of the atmosphere; the lowest level is in February, and the highest in December. Nice is not a good harbour of refuge as there are few berths, and south-westerly winds cause a swell; the Rade de Villefranche is better for this purpose. The entrance to the port of Nice opens laterally to the coast, and thus can be made in bad weather. The harbour lies between the hill rising to 300 m., on which the Château stands, and Mont Boron, 500–750 m. high, the ridge which terminates in the Cap de Nice, and is protected by a breakwater extending south-eastwards from the Château. The outer

pass leading to the avant-port is 105 m. wide, and free from under-sea dangers.

Detailed Description

The harbour comprises an avant-port and three open basins, and can be used by vessels drawing 6·85 m. (22·5 ft.). The avant-port, 150 m. wide, is contained by the Epi de la Poudrière, a ridge of rocks, and the Traverse du Commerce, the first interior mole; it is not suitable for an anchorage, as south-easterly seas can enter.

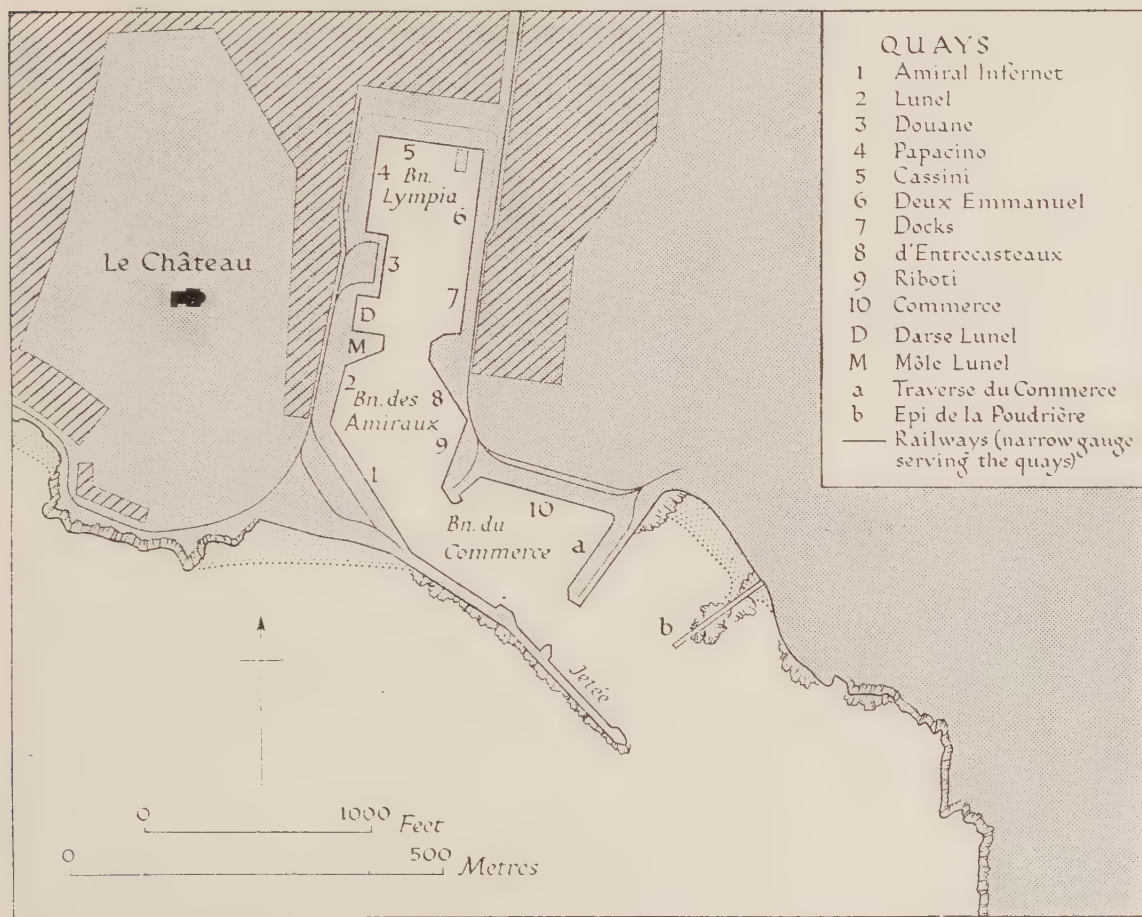


Fig. 59. Nice

Accommodation

Basin	Length m.	Width m.	Maximum length of vessel admissible		No. of berths	Draught at berths	
			m.	ft.		m.	ft.
Bassin du Commerce	200	180	125	410	3	6·85	22·5
Bassin des Amiraux	200	155	100	328	2	6·0	19·7
Bassin Lympia	280	155	100	328	2	6·85	22·5
					1	5·0	16·5
					2	6·0	19·7
					2	6·5	21·3



The total length of the quays is 1,533 m. All the quays are public; they have for the most part specialized uses:

Papacino	Corsica packet boat
Commerce	Coal and wood
Commerce Traverse	Oil and explosives
Cassini	Pleasure craft
Deux-Emmanuel	Coastwise traffic
Docks	Small pleasure craft
D'Entrecasteaux	Sand and gravel
Infernet	North part: wine, oil and cereals from Algeria and Tunisia; south part: coal, wood, limestone and cement for export
Douane	Marseilles packet boat
Caboteurs	Mainly small naval craft
(See Plates 55, 56)	

### *Port Facilities*

The quays are equipped with fourteen electric cranes of under 10 tons capacity, two of which are fitted with hoppers for coal discharging; there is also a 30-ton fixed electric crane. Repair equipment includes three lifting bridges and two patent slips 88 and 50 m. long.

### *History*

The first works at this port, principally a sheltering mole, date from the middle of the eighteenth century; basins were not constructed until 1792, and remained in their original lay-out till 1865. When the County of Nice was annexed by France in 1860, the mole had been lengthened and quays had been built; the port also possessed an inner basin, and a careening basin. By the turn of the century a new basin was required, and the Epi de la Poudrière was constructed in 1910 to form the outer port. The jetty was lengthened twice to meet the expansion of the harbour, and depths were increased. Considerable works were undertaken between 1913 and 1924, including the construction of the Carénage quay, and the Infernet quay with its flat storage ground, while the Lunel mole was enlarged and the entrance channel straightened.

The moderate expansion of the port has not kept pace with the rapid expansion of the town in recent decades. In the last century its population grew steadily to 105,000, but in the period 1907-36 it grew much more rapidly and now amounts to 242,000. There are few industries other than food packing, etc., for the silk textile industry is now moribund. The lack of any considerable industrial activity is clear from the trade returns for the port.

*Trade**Cargo Movements, 1937 (thousands of tons)*

Foreign trade: Imports	248·7
Exports	37·6
Total	286·3
Coastwise trade (total)	63·2
Total sea-borne trade	349·5
Total foreign trade 1938 (provisional figures)	390·8

The export tonnage is enlarged through the proximity of three lime and cement works, the products of which are sent to Tunis and Algeria. The sea-borne cargo traffic is small, although Nice lies 200 km. from the nearest commercial port. The increase since 1865, when 81,000 tons were handled, is not very great for a period of 75 years. The activity of the port is extended, however, by the passenger traffic: in 1938 passengers numbered 102,000, with arrivals slightly in excess of departures; the total tonnage of shipping entered and cleared has doubled in recent years: in 1925 it amounted to 0·68 million tons, in 1935 to 1·68 million tons. The tonnage of shipping engaged in foreign trade amounted to 0·735 million tons in 1937.

*Communications*

The railway connexions of the port are more complicated than in most. The inter-urban metre gauge electric tramways, which serve the town, run on to the quays, and are connected with the metre gauge railway, Chemins de Fer de la Provence, at its station. This line serves more distant towns like Digne, Grasse, etc. The connexion between the port lines and the normal gauge is finally made at two transit junctions, one at the C.P. station near the main P.L.M. station of the town, and one at the Nice-Saint-Roch station, on the Nice-Coni line, 3·5 km. from the port. The Nice-Saint-Roch station handles 1,000 tons of goods daily, more than three times the amount handled by the town junction, since it possesses a sorting yard. The railways carry away half the coal imports, and bring two-thirds of the lime and cement exports; the rest of the tonnage is carried by road. The main railway passing through Nice is the coastal line of the P.L.M. from Marseilles to Ventimiglia, which was complete in 1872. The single-track line from Nice to Coni, opened in 1928, is of limited value as a link with Turin and the industrial area of northern Italy, for its daily capacity is only fifteen trains each way. In general, owing



to the proximity of the Maritime Alps, communications by road and railway are very difficult for heavy commodities.

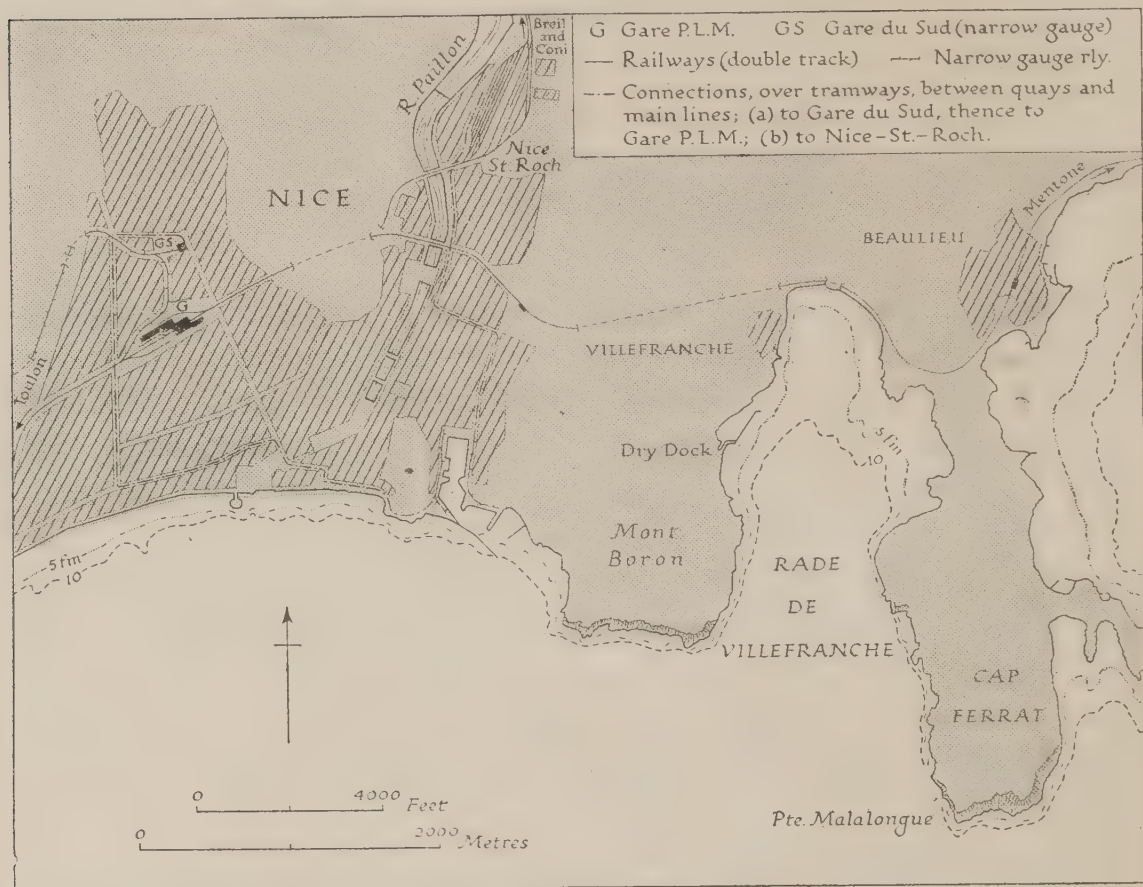


Fig. 60. Nice and the Rade de Villefranche

### VILLEFRANCHE

About 2 km. east of Nice, between the range ending in Cap de Nice, and the peninsula of Cap Ferrat, lies the roadstead of Villefranche, which is attached to the port of Nice for administrative and customs purposes. The roadstead is 350 ha. in area, with depths of 25–60 m. (82–197 ft.), and is the safest for large liners between Marseilles and Genoa. The port comprises two very small basins, separated by a small mole, with depths of 6.1–7 m. (20–23 ft.) in the eastern part to within 12 m. of the mole. There are no facilities for discharging cargo; only a few hundred tons are landed in some years. There is a dry dock 260 m. (853 ft.) long, though there is some doubt as to whether it is usable. Passengers using the port formerly disembarked from ships berthed at the mole, but in 1930 arrangements were made for landing passengers by means of motor launches. Since then a passenger traffic of appreciable dimensions has developed; in 1931,





Plate 55. Nice: the Bassin du Commerce, the outermost basin of the port  
(looking south-east)

The two moored vessels are alongside the Quai du Commerce. In the left foreground is the Quai d'Entrecasteaux of the Bassin des Amiraux.



Plate 56. Nice: outer quays of the port (looking south-east)

The moored vessel is discharging Algerian wine at the Quai Amiral Infernet.





Plate 57. Rade de Villefranche (looking south-east)

This roadstead offers the safest anchorage between Marseilles and Genoa used by large passenger liners; it is safe in all weathers. Mooring buoys are provided for French naval vessels.



5,000 passengers arrived or departed; in 1935, 9,500, and in 1938, 5,600. The tonnage of vessels calling is considerable, amounting to 6,245,000 entered and cleared in 1937, and is due for the most part to Italian lines—out of 358 liners moving in and out of the port 210 were Italian, 72 Dutch, 30 German, 24 English and 22 French (see Plate 57).

## MINOR PORTS OF THE MEDITERRANEAN

The minor ports of the Mediterranean coast lie mostly to the east, along the Riviera coast, but there is one in Languedoc—*La Nouvelle*. Its harbour is formed by the canal which connects the Etang de Gages and the Etang de Sijean with the sea, and which is prolonged seawards by two jetties. The port provides six berths at less than 6.0 m. (19.7 ft.), but is generally used by smaller craft. There are 680 m. of quay, equipped with two cranes of 3–9 tons capacity. The trade is mainly with foreign countries, and there is a considerable passenger traffic. *La Nouvelle* (pop. 1,700) is the nearest port to Narbonne (pop. 26,000), being only 22 km. distant. It is also as near Béziers (pop. 67,000), the centre of the vine-growing district, as is Sète.

### *Trade of the Minor Mediterranean Ports*

	No. of ships	Foreign trade (thousands of tons)				Coasting trade (thousands of tons)		
		Net tonnage	Im- ports	Ex- ports	Total cargo	In- wards	Out- wards	Total
La Nouvelle	121	98.5	57.5	0.3	57.8	6.0	—	6.0
Cassis	30	19.1	—	11.0	11.0	0.4	109.6	110.0
La Ciotat	—	—	—	0.1	0.1	0.5	9.9	10.4
St Tropez	12	8.0	—	3.7	3.7	2.1	—	2.1
St Raphaël	49	46.2	5.3	23.0	28.3	3.8	3.8	7.6
Cannes	33	60.2	25.0	0.5	25.5	6.0	0.1	6.1
Antibes	44	4.2	1.9	2.2	4.1	25.5	—	25.5
Monaco	53	217.9	24.2	0.8	25.0	2.1	—	2.1
Menton	5	4.3	6.4	—	6.4	0.6	—	0.6

Few ports are found in the neighbourhood of the Rhône delta. Beyond Marseilles is *Cassis* (pop. 1,800), on the Baie de Cassis, where there is a harbour for small ships within a mole. Foreign traffic is insignificant, but there is a heavy coastwise export of limestone to Giraud-Barcarin on the Rhône above St Louis.



*La Ciotat* (pop. 10,000), roughly half-way between Marseilles and Toulon, is a shipbuilding centre rather than a seaport. The harbour is formed by two moles, with a width at the entrance of 90 m. and a depth of 6.1 m. (20 ft.). The area of the harbour is 8 ha., with a length of 255 m. and a width of 170 m. The length of quayage is 728 m.; there are two 150 m. berths, two of 125 m. and one of 100 m.; depths alongside are 3.0 m. (10 ft.), and in the central part of the harbour depths vary from 4.9 to 6.1 m. (16–20 ft.). There is a crane on the Quai des Messageries Maritimes, and there is also one 80-ton floating sheer legs. The dry dock has a useful length of 140.5 m. (461 ft.) and a depth on the sill of 6.5 m. (21–25 ft.). Repairs can be executed. General trade is very small, consisting of imports of iron and timber, and exports of wine, olive oil and fish. Except for a few fishermen the population is employed at the shipyard of the *Société Provençale de Constructions Navales*. This yard has two slips, of which the longest is 160 m. in length, and can build ships up to 16,500 tons. It is reported that aircraft are also constructed here. (See Plate 52.)

Beyond Toulon almost every bay possesses a harbour; port facilities are generally suitable only for small ships, but larger vessels can anchor in some of the roads to land passengers. *Mines du Plomb* is a small harbour with a jetty, in the Rade d'Hyères. A narrow-gauge railway connects it with some zinc mines. *St Tropez* (pop. 3,200), *Antibes* (pop. 1,400) and *Menton* (pop. 18,300) engage in a small foreign and coastal traffic; St Raphael, Cannes and Monaco are rather larger. *St Raphaël* (pop. 6,800) can accommodate one 3,000-ton ship at its quay, where the draught is as deep as 8.5 m. (28 ft.). At *Cannes* (pop. 40,400) part of the mole has depths alongside of 5.5 m. (18 ft.). The harbour is not fitted for commercial traffic, but schemes for its extension and deepening are envisaged. *Monaco* (Monte-Carlo, pop. 9,400) has a considerable traffic in larger ships which call, but little cargo is handled. The quays are available for vessels drawing up to 7.0 m. (23 ft.). The offices of the International Hydrographic Bureau are situated here.

*Cros de Cagnes* and *Les Salins d'Hyères* are ports with a very small trade.

## FUTURE DEVELOPMENTS IN FRENCH PORTS

The position of France in Europe and the internal geography of the country have not favoured the development of any port of the first magnitude. Much of her commerce passes over the eastern land frontier; no great export coalfield lies near the sea; her exports are largely goods of high value and small bulk; and her position does not allow of any considerable function in transit trade. The great extent of coastline allows of a dispersal of the coal and petroleum imports which make up a great proportion of the inward cargoes. As a whole the volume of traffic tends to be divided rather than concentrated owing to the location of the ports and centres of population. The traffic of the Paris basin is divided between the ports of Havre and Rouen. Marseilles competes with Antwerp and the Rhine ports for the trade of eastern France. The trade of the north-eastern coalfield is not entirely a preserve of Dunkirk, for the competition of Antwerp is always pressing. In western France the newer port of La Pallice has secured a footing in the region where Bordeaux competes with Nantes and St Nazaire.

While the position of France in relation to the principal centres of population in Europe limits the possibilities of transit traffic in merchandise, it is of some advantage in passenger traffic, for Cherbourg and Havre are well placed to intercept the mail and passenger movement between north-west Europe and the Americas. They succeed in skimming the cream of the fast traffic, but in recent decades national frontiers have become less open. Free competition between ports in Europe has been progressively reduced owing to the development of national policies which foster national ports, national liner services, and national railway systems. On the other hand, France is excellently placed for the traffic between Great Britain and the Mediterranean and south-eastern Europe, an advantage which is not likely to diminish.

Whatever may be the future of the ports of France as far as could be seen in 1939, extensive schemes for the expansion of many ports were under consideration. It is difficult to estimate how far it was thought likely that these schemes would actually be realized, but they at least implied some contemplation of expanding trade. The French ports can hardly expect to secure any heavy increase in their trade by trespassing upon the hinterlands of ports which lie to the east. The question arises, therefore, as to exactly what trade these proposed improvements are to be related. In a country in which



state guidance of enterprise is very effective, it is all the more surprising that there should be potential competition among ports for traffic which cannot expand as much as the port facilities are designed to expand. It must be remembered, however, that there is strong competition between local interests, and that each port must fight persistently to maintain its trade against the constantly changing attack of a variety of factors—the demand by traders for quicker turn round, the increase in the size of ships, changes in the nature of commodities handled, and the sensitiveness of passenger traffic to more attractive shore facilities and transport connexions. The activity of each port represents much of the prosperity and employment available in its locality. It is therefore a matter of great material interest for the Loire ports, for example, to maintain their traffic against the competition of La Pallice or Brest or St Malo. Rouen must aim at securing as much as possible of a new traffic like the import of petroleum against the competition of Havre. Havre cannot slacken in its efforts to attract what miscellaneous traffic it can from the northern coalfield.

It should be remembered that the six principal ports of France have a relative advantage over the remainder in the financing of new works, for the state furnishes a greater proportion of the loans for development schemes for the larger ports than for the smaller ones. Thus the advantage already possessed by the chambers of commerce of the leading ports, in that they are able more easily to raise loans from local resources, tends to be perpetuated by the system by which state loans are granted. The situation arises because the government regards the six principal ports as being of primary importance to the economic prosperity of the country as a whole. State assistance is provided in the following proportions:

	Source of financial assistance for improvement schemes	
	State	Local interests
Principal ports: Dunkirk, Rouen, Havre, Lower Loire (Nantes and St Nazaire), Bordeaux, Marseilles	50 %	50 %
'Ports moyens'—secondary ports	33 $\frac{1}{3}$ %	66 $\frac{2}{3}$ %
Minor ports	25 %	75 %

The question of port competition is intimately bound up with the development of internal transport within the country. With the nationalization of the railway companies controversial questions of the future have come to revolve mainly around waterway develop-

ments. The improvement of the Rhine navigation and expansion of the inland port of Strasbourg tend to draw the movement of heavy goods from eastern France to the Rhine ports rather than to Dunkirk or Havre, and even leads to competition between Rotterdam and Antwerp for the provision of concessions. Marseilles is concerned with the long-discussed project for the improvement of the Rhône navigation, hoping thereby to strengthen its competitive position in the region from Lyons to Strasbourg and eventually eastwards to Basle. Bordeaux, La Pallice, St Nazaire and Nantes aim at extending their hinterland by rail transport into central and eastern France and even to Switzerland. The heart of the country, therefore, lying between Strasbourg, Paris, Clermont-Ferrand and Lyons, is a frontier between the potential hinterlands of all the leading French ports, and of Antwerp and Rotterdam as well. The existence of Strasbourg is an important factor in the traffic movements of this region, too: the inland port competes with Rouen and Havre for Swiss imports, such as Scandinavian timber and wood-pulp, while its authorities aim at extending southwards towards Lyons the area served by water-borne Ruhr coal, at the expense of English sea-borne coal imported through Marseilles.

### *Port Development Schemes*

The various proposals for the expansion of certain French ports have not been shown in the illustrations to the foregoing accounts, since it is difficult to determine how far they are likely to materialize. The following series of illustrations indicate the plans envisaged. They demonstrate the possibilities which are open and the sites which are suitable, and they show that the majority of French ports are capable of developing accommodation to meet any possible expansion of trade.

At *Dunkirk* the maximum scheme is for a series of docks as large as the existing system, lying to the west. Part of the work has been accomplished in that the new lock is complete and the new turning basin is in process of excavation. Besides improving access to the existing docks, the new lock would lead also to the extensions. At *Calais* the construction of a new basin to the north-east of the existing harbour is contemplated; at *Boulogne*, on the other hand, much attention is being given to the development of the anchorage inside the breakwater as a port of call for large vessels, with a mole and maritime station.

The *Havre* plans contemplate a series of large docks to the eastern



side of the present port, and representing an extension of the present Bassin de Marée. These would lie along the estuary and would be entered by means of a large lock from the Bassin de Marée, and would be connected northwards by a further dock to the enlarged Tancarville Canal. *Rouen* has comparatively modest ambitions for dock extension, only one basin being at present actively contemplated, and much more attention is being paid to the possibility of deepening the Seine to permit access to the Petit Couronne refinery by large tankers.

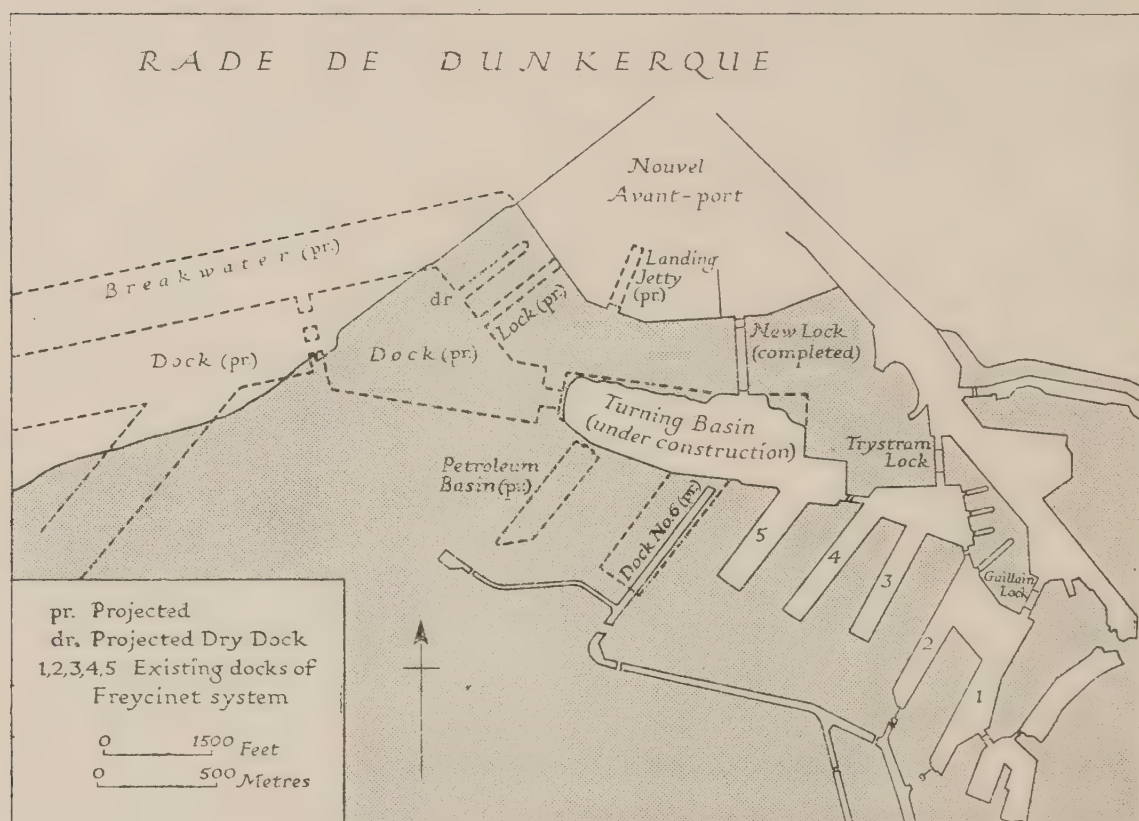


Fig. 61. Projected extensions at Dunkirk (see also pp. 14, 19)

Of the western ports *St Nazaire* has developed plans for a large basin extending into the estuary to the east of the present port, and at *Nantes* there are recurrent proposals for the construction of basins on the left bank, opposite the lower quays. Extensive moles for tankers are planned to accommodate the growing petroleum traffic at *Donges*, and this scheme seems very likely of realization. At *Bordeaux* a project for a canal parallel to the river and leading to a series of basins has been contemplated since the early years of this century, but the work has never been started. More attention has been devoted to the development of the new outpost at *Le Verdon*.

Plans at *Bayonne* are concerned mainly with the improvement of the river by constricting the water area and increasing the depth.

On the Mediterranean coast, *Port Vendres* is concerned more with shore facilities than with further basins. *Sète* is fortunate in possessing the extensive lagoons behind it, which provide ample land

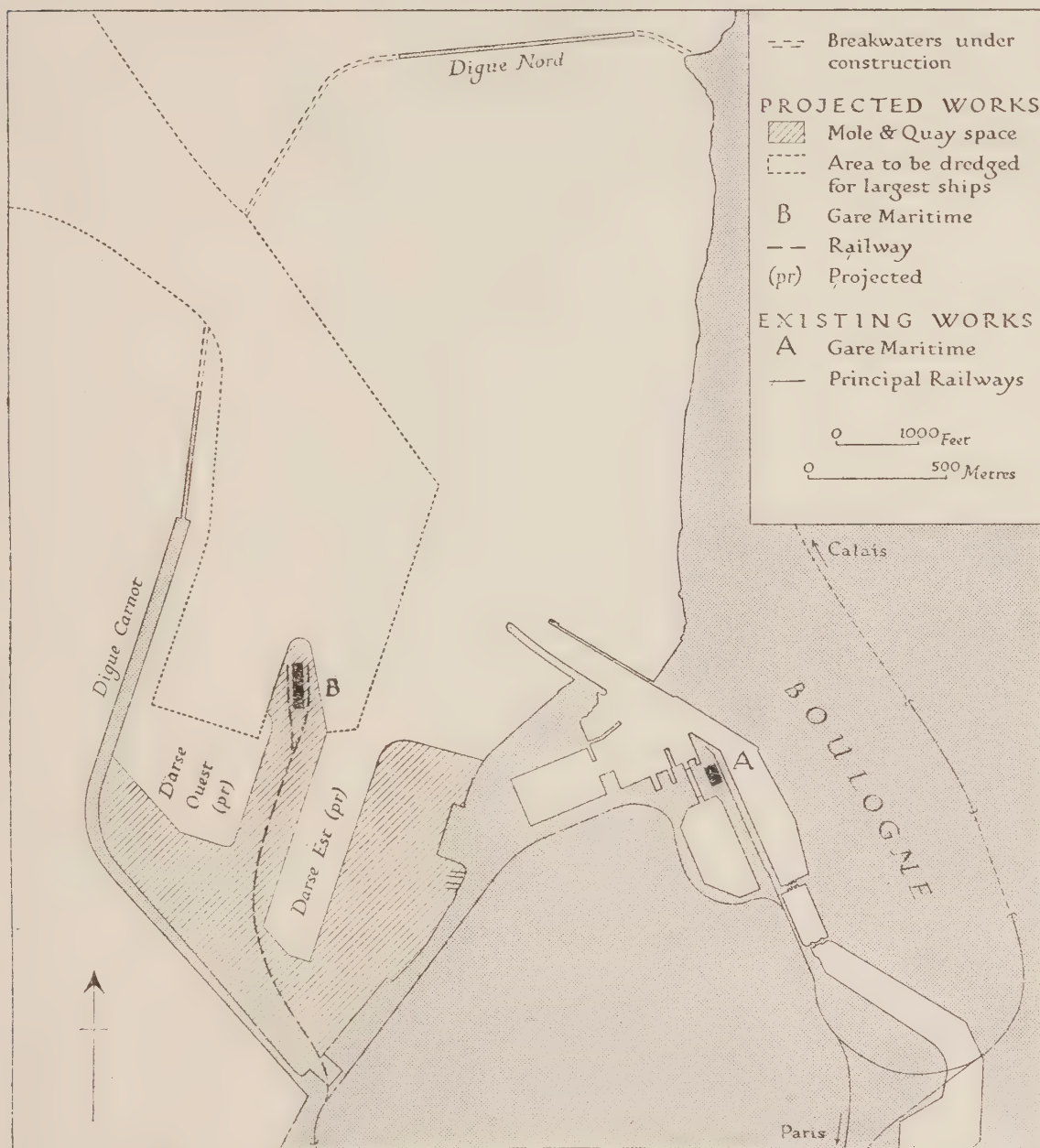


Fig. 62. Projected extensions at Boulogne (see also p. 33)

for factories and convenient water approaches. Little elaborate construction is necessary, and dredged channels and berths can be extended as trade requires. At *Marseilles* itself two new basins are in process of construction, to the north and south of the present port. It is not easy to visualize the scale of the whole series of developments at *Marseilles*: the existing port handles the largest



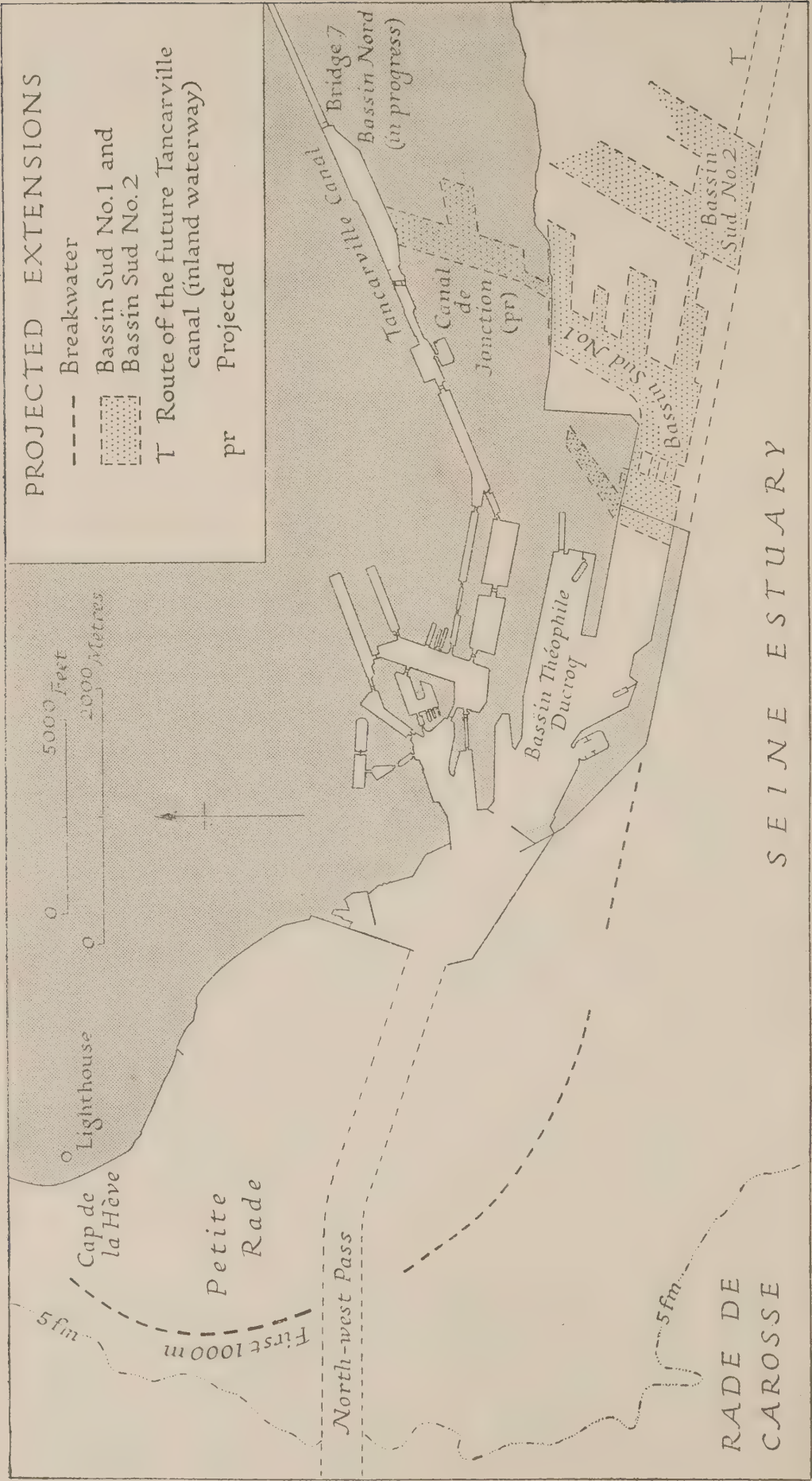


Fig. 63. Projected extensions at Havre (see also p. 48)

Of this considerable scheme of extensions, the Bassin Nord has been virtually completed by the widening of the Tancarville Canal. The Bassin Sud No. 1 will be the next work to be undertaken, followed probably by the Canal de Jonction. The Bassin Sud No. 2 will not be undertaken for some considerable time. If the trade of the port warrants yet further extensions, additional basins can be constructed eastwards of Bassin Sud No. 2.

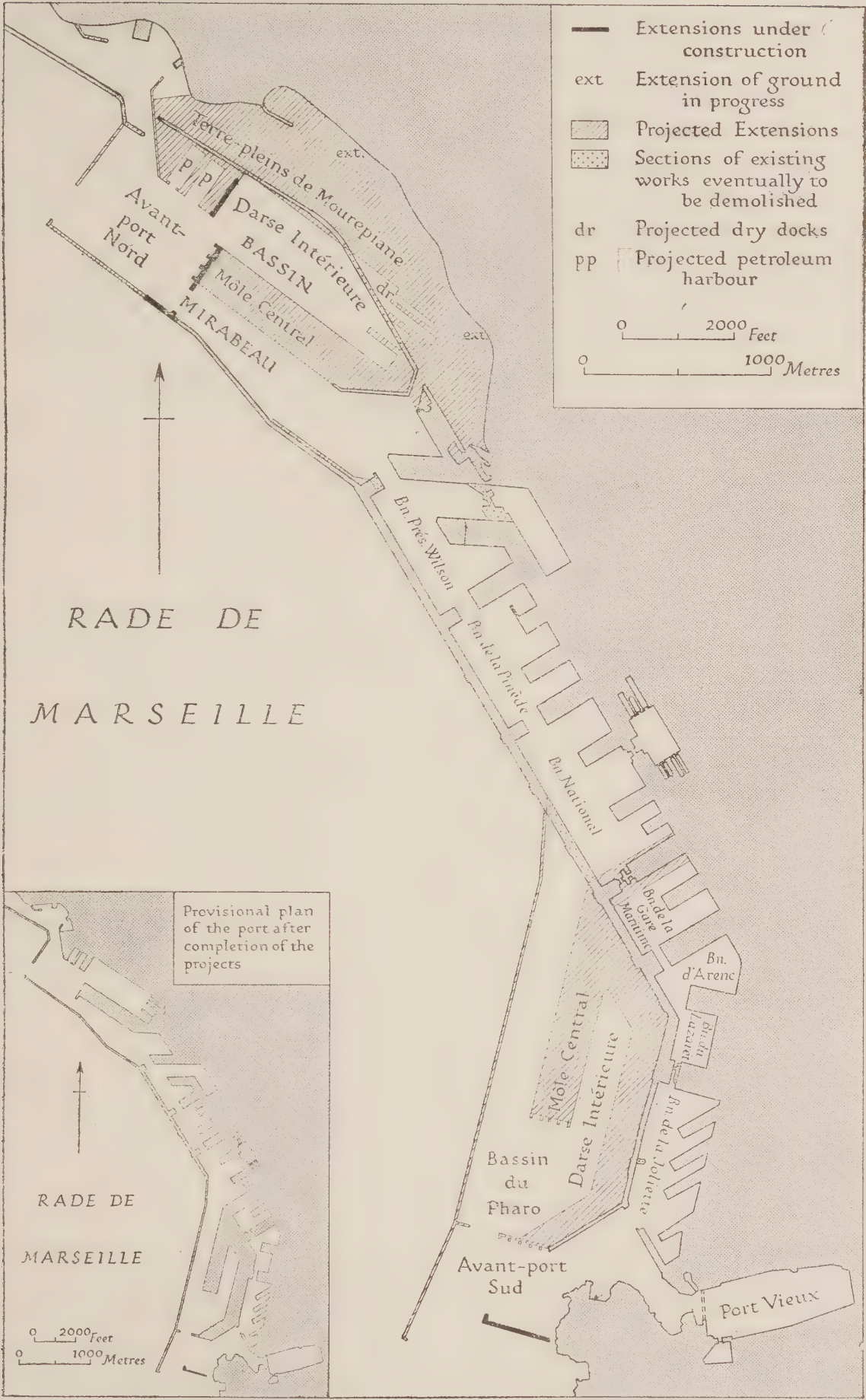


Fig. 64. Projected extensions and work in progress at Marseilles  
(see also pp. 184-5)



shipping tonnage of any in France, yet the new basins will approximately double the capacity. Even sections of the breakwater, so laboriously built up, are being removed. The various projects for the establishment of quays along the Etang de Berre and Etang de Caronte are almost unlimited in scope and can hardly be shown by hard and fast lines. Most work has been done in the Etang de Caronte, and here the south side is now being developed. The subsidiary *Bouc-Berre* ports along these lagoons have developed, in a short history of 25 years, a tonnage almost equal to that handled by Nantes, but the planned additions, if completed, will surpass by far those existing. It is clear that the port authorities of Marseilles intend that their facilities shall be capable of dealing with any conceivable increase of trade in the future.

#### BIBLIOGRAPHICAL NOTE

(1) There is no comprehensive account of the French ports in English, although the literature on the subject is extensive. The following list of books is intended as a guide to further reading as well as a list of references employed in the foregoing three chapters.

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(3) The following treatises on dock and harbour engineering refer to examples in France, especially the first one:

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B. Cunningham, *Harbour Engineering* (London, 1928).

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(4) The Department of Overseas Trade reports contain chapters on the equipment of the ports and on recent improvements which have been carried out:

R. Cahill, *Economic Conditions in France*, 1934 (London: Department of Overseas Trade, 1936).

*La Pétrole en France* (Paris, 1937)—a special number of *La Revue Pétrolifère*; this account of the French refining industry contains a number of references to discharging facilities.

J. Brunhes and P. Deffontaines, 'Sites et Types de Ports', Ch. 25 of *Géographie Humaine de la France*, vol. II of *Histoire de la France*, ed. G. Hanotaux (Paris, 1920). Though out of date, this chapter is an admirably lucid account of the site, history and economic problems of each of the principal ports, and attempts briefly to delimit their hinterlands.

(5) The trade statistics for the French ports appear in the following returns, which are issued annually:

*Tableau Générale de la Navigation Extérieure*, 1937 (Imprimerie National, Paris, 1938). This volume contains statistics, both detailed and in summarized form, for the coasting and foreign trade of 108 individual ports, by tonnage of cargo and of shipping; these tonnages are further analysed by nationality, port of origin and port destination. It contains also detailed tables concerning the state of the mercantile marine.

*Tableau Générale de la Commerce Extérieure*, 1938 (Imprimerie National, Paris, 1939). These statistics apply to the ports only in that they give the figures of movements through the customs, by weight and by value, at the larger ports.

(6) The following periodicals contain much valuable information on port extensions. The letters in parentheses indicate the abbreviations by which each periodical is referred to below.

*Special Register of Information*, London, Department of Overseas Trade; Periodical typescript (S.R.).

*The Dock and Harbour Authority*, London (D.H.A.).

*Le Génie Civil*, Paris (G.C.).

*Annales des Ponts et Chaussées*, Paris (P.C.); the articles in this publication are authoritative and complete.

A useful guide to references on engineering problems is *Engineering Abstracts*, London (E.A.). This publication contains abstracts in English of articles from the above periodicals and from many others.

*La Revue Pétrolifère*, Paris (R.P.), deals with petroleum installations and discharging facilities.

(7) Other periodicals which describe port equipment are:

*Technique des Travaux*, Paris.

*Jahrbuch der Hafenbautechnischen Gesellschaft*, Berlin (H.T.).

*Annales de Géographie*, Paris (A.G.)—this publication contains a number of studies of ports, mainly from the view-point of trade and industry.

*Journal de la Marine Marchande*, Paris (M.M.)—this periodical is devoted to the French mercantile marine but touches upon a variety of topics connected with ports.

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# THE TRADE OF THE FRENCH PORTS: SUMMARY

## FOREIGN AND COASTWISE TRADE, 1937 ('NAVIGATION' FIGURES)

*Tonnage of Cargo Handled, in metric tons*

	Foreign			Coastwise		
	Inwards	Outwards	Total	Inwards	Outwards	Total
Marseilles	3,677,910	1,954,888	5,632,798	301,279	347,183	648,462
Bouc	1,887,815	372,893	2,277,801	134,527	198,040	332,567
La Mède	389,986	145,754	535,740	—	207,974	207,974
Rouen	7,631,672	670,344	8,302,016	1,195,292	269,914	1,465,206
Honfleur	142,762	5,134	147,896	17,977	16,210	34,187
Villequier	20,992	1	20,993	789	—	789
Duclair	24,747	321	25,068	34,789	67,355	102,144
Le Trait	19,420	1,473	20,893	6,605	1,534	8,139
Port Jérôme	—	39,525	39,525	3,902	783,680	787,582
Havre	4,497,730	794,995	5,292,725	278,073	808,383	1,086,456
Bordeaux	2,526,151	799,768	3,325,919	556,474	193,218	749,692
Mortagne	12,035	267	12,302	22,130	15,219	37,349
Pauillac	492,123	120,446	612,569	89,921	227,516	317,437
Blaye	89,467	45,301	134,768	40,917	44,465	85,382
Furt	2,330	56	2,386	25,047	21,824	46,871
Bec d'Ambes	338,942	52,982	391,924	229	207,184	207,413
Dunkirk	2,995,823	1,032,177	4,028,000	92,302	420,602	512,904
Nantes	1,581,437	516,637	2,098,074	291,063	85,383	376,456
Basse Indre	122,868	28,788	151,656	11,421	4,587	16,008
Couéron	13,484	201	13,685	4,139	976	5,115
Paimbœuf	16,716	1,254	17,970	4,097	473	4,570
Donges	363,048	58,347	421,395	4,924	231,542	236,466
St Nazaire	437,953	25,920	463,873	86,907	28,923	115,830
Caen	1,240,297	788,751	2,029,048	91,544	56,242	147,786
Ouistreham	—	—	—	2	642	644
Sète	962,075	189,519	1,151,594	43,406	29,189	72,595
Boulogne	534,436	366,099	900,505	24,441	107,420	131,861
Calais	652,872	29,009	681,881	7,788	51,959	59,747
Bayonne	567,940	126,344	694,284	44,039	25,700	69,739
La Pallice	553,905	72,081	625,986	46,669	10,037	56,706
La Rochelle	263,909	72,160	336,069	17,657	13,689	31,346
Brest	403,922	211,947	615,869	294,670	128,146	422,816
Dieppe	442,108	111,195	553,303	7,622	8,304	15,926
St Malo	414,298	68,144	482,442	40,711	21,582	62,293
Lorient	359,445	68,672	428,117	73,490	33,037	106,527
St Louis du Rhône	268,276	59,520	327,796	377,434	128,146	505,580
Nice	248,733	37,648	286,381	20,798	42,446	63,244
Villefranche	52	133	185	—	—	—
Tonnay-Charente }	196,141	49,209	245,350	6,380	3,432	9,812
Rochefort }	169,891	320	170,211	10,554	6,896	17,450
Cherbourg	155,267	72,593	227,860	78,125	19,165	97,290
Toulon	11,378	182,468	193,846	15,308	4,927	20,235
La Seyne	34,342	21,483	55,825	63,221	599	63,820
Port Vendres	103,181	12,795	115,976	10,518	1,424	11,942
Minor ports						
Granville	81,023	78,844	159,867	21,903	5,069	26,992
Le Tréport	82,855	18,102	100,957	—	—	—
Fécamp	82,315	11,543	93,858	8,366	726	9,092
Deauville-Trouville	83,457	10,033	93,490	12,532	10,033	22,565
Le Légué (incl. Dahouet)	86,053	2,420	88,473	33,590	6,218	39,808
Les Sables d'Olonne	69,813	1,319	71,132	2,858	11,054	13,912
Gravelines	68,277	2,487	70,764	180	—	180
La Nouvelle	57,498	2,979	60,477	6,050	—	6,050
Morlaix	37,284	1,148	38,432	16,094	7,280	23,374
Arcachon	29,736	4,531	34,267	—	20	20
Quimper	29,870	148	30,018	15,474	2,327	17,801
St Raphael	5,347	23,077	28,424	3,826	3,814	7,642
Cannes	24,984	478	25,462	6,078	162	6,240
Vannes	17,199	7,843	25,042	13,467	1,839	15,306
Monaco	24,232	794	25,026	2,147	28	2,175
Paimpol	17,822	684	18,506	23,665	11,559	35,224
Roscoff	4,627	10,249	14,876	530	141	571
Cassis	—	11,017	11,017	422	109,600	110,022
Lannion	9,553	492	10,045	2,946	1,020	3,966
Marans	9,815	81	9,896	1,491	6,554	8,045
Douarnenez	8,188	1,204	9,392	15,803	4,728	20,531
Tréguier	9,075	27	9,102	4,028	16,282	20,310
Concarneau	5,066	2,860	7,926	19,332	10,288	29,620
Quiberon	3,995	3,207	7,202	7,580	1,591	9,171
Menton	6,420	16	6,436	607	62	669
Loctudy	5,969	236	6,205	2,979	1,011	3,990
Isigny	5,041	553	5,594	353	—	353
Courseulles	5,534	11	5,545	1,313	—	1,313
St Valéry-sur-Somme	—	5,054	5,054	906	3,063	3,969
La Trinité	1,921	2,847	4,768	203	160	363
Landerneau	4,180	—	4,180	16,241	561	16,802
Antibes	1,931	2,243	4,174	25,502	—	25,502
Port-en-Bessin	2,959	1,189	4,148	322	—	322
Pont l'Abbé	3,797	—	3,797	5,979	1,825	7,804
St Tropez	—	3,718	3,718	2,088	9,887	11,975
Audierne	2,732	765	3,497	8,561	1,661	10,222
St Valéry-en-Caux	210	3,000	3,210	—	—	—
Abbeville	526	—	526	3,497	3,295	6,792



## THE FOREIGN TRADE OF THE FRENCH PORTS

In the foregoing descriptions, statistics have been given which indicate the movements of cargo through each port for the year 1937, the latest year for which official returns are available. These figures indicate the total weight of cargo, both in the foreign and coastwise trade, landed and discharged. They are derived from the Navigation returns. Detailed statements of the commodities entering into foreign trade are not published for each port, but only for a certain number, which are known as the principal 'douanes' or customs clearing points. (Paris and Strasbourg are also among the principal 'douanes'.) These detailed statements are given below as far as they are published: they are derived from the Commerce returns. Statements are not available for Caen, Cherbourg, St Malo, Brest, Lorient, Rochefort, Tonnay-Charente, Port-Vendres, St Louis-du-Rhône and Toulon. Broadly speaking, these statistics serve for analyses of the foreign trade of the ports concerned, but they are not quite complete. As a rule the weight of imports registered under each douane is a little smaller than that stated in the navigation returns. The discrepancy arises from a combination of four factors: the navigation returns employ gross weights and the 'douane' figures net weight; petroleum imported in a crude state does not, for the greater part, enter the 'douane' calculations until it has been refined, and similarly with some imported raw sugar; goods in transit to foreign countries are not reckoned as having entered the French customs area; and finally, some goods enter at one port, but pay the duty at another. In short, the navigation returns provide a statement of the weight of foreign cargo brought into a port by incoming vessels, while the commerce returns indicate the weight of imported cargo handled by customs arrangements. In actual fact, the greater part of the difference between the two statements of imports arises from the petroleum import.

Discrepancies between the figures for exports in the foreign trade are very much smaller, but arise from similar causes.

The fifteen detailed 'douane' statements which follow are for the year 1938, the latest available, and are arranged in order of magnitude of the weight of imports. For purposes of comparison the 'douane' tonnages for 1937 and the 'navigation' tonnages for 1937 have been added.

*Trade of the fifteen seaports which are among the principal 'douanes' 1938 (thousands of metric tons).*

## MARSEILLES AND SUBSIDIARY PORTS

<i>Imports</i>				<i>Exports</i>			
Fuels ... ..	...	...	2,606.8	Manufactures ... ..	...	...	248.1
Petroleum	1,425.0			Textile manufactures	37.0		
Heavy oil and petroleum residue	135.7			Jute	3.9		
Coal, etc.	1,044.0			Cotton	26.1		
Minerals and metals ... ..	...	...	137.9	Silk, rayon, etc.	3.0		
Iron and steel	1.3			Silk yarn	1.0		
Copper	10.5			Soap and perfumes	47.2		
Lead	9.6			Pottery and glassware	22.2		
Tin	1.2			Paper and cardboard, etc.	25.7		
Zinc	0.8			Machines and machine parts	19.9		
Nickel	0.1			Boilers	1.2		
Others	114.3			Vehicles, except auto-mobiles	4.4		
Chemical materials ... ..	...	...	140.7	Automobiles	13.0		
Coal-tar pitch	7.2			Ships	1.9		
Sulphur and pyrites	66.3			Other metal manufactures	27.4		
Stone and earth, mainly natural phosphates	56.7			Other manufactured goods	48.1		
Others	10.5			Metals and minerals ... ..	...	...	158.3
Timber, etc. ... ..	...	...	36.8	Aluminium	1.8		
Common timber	17.1			Pig iron	12.6		
Exotic	8.0			Iron and steel	35.7		
Cellulose pulp	11.7			Copper	1.8		
Textile materials ... ..	...	...	77.6	Zinc	1.1		
Wool and cotton	61.2			Lead	0.9		
Jute	3.3			Tin	0.2		
Rags	2.8			Other minerals	104.0		
Others	12.3			Chemical products ... ..	...	...	100.2
Textile tissues ... ..	...	...	12.4	Tar, bitumen and asphalt	2.3		
Jute	9.7			Sulphur and pyrites	6.6		
Silk	1.8			Phosphatic fertilizers	17.5		
Rubber ... ..	...	...	36.6	Sodium chloride	6.6		
Oilseeds ... ..	...	...	625.4	Tartaric acid	13.9		
Tobacco (leaf) ... ..	...	...	4.6	Others	53.3		
Vegetable oils ... ..	...	...	30.3	Wine, spirits, beer and mineral waters	44.0		
Olive oil	20.4			Wine	17.0		
Wine and spirits ... ..	...	...	119.3	Mineral waters	16.9		
Wine	117.3			Foodstuffs ... ..	...	...	243.6
Foodstuffs ... ..	...	...	1,211.0	Potatoes	44.8		
Grain flour, etc.	440.1			Sugar and sugar preparations	89.0		
Groats, barley, etc.	43.8			Cereals, groats, etc.	43.7		
Rice	121.6			Vegetable oils, etc. ... ..	...	...	73.6
Dried vegetables, etc.	72.6			Textile materials ... ..	...	...	8.4
Fresh vegetables	72.4			Rags	2.5		
Potatoes	46.1			Wool	1.8		
Fruit	194.1			Raw silk	0.1		
Raw and refined sugar	155.1			Silk yarn	1.1		
Coffee	23.5			Fuels ... ..	...	...	118.4
Cacao	4.3			Coal	0.5		
Miscellaneous ... ..	...	...	101.9	Petroleum	81.9		
Total: 1938	5,241.6			Heavy oil	35.8		
1937	5,652.0			Timber ... ..	...	...	15.2
Navigation tonnage, 1937	5,955.7			Common timber	13.6		
				Exotic	1.5		
				Miscellaneous ... ..	...	...	180.7
				Total: 1938	1,190.5		
				1937	1,292.9		
				Navigation tonnage, 1937	2,473.5		



## ROUEN

<i>Imports</i>				<i>Exports</i>				
Fuels	...	...	...	3,918.6	Manufactures	...	...	31.7
Petroleum, etc.			742.2		Paper and cardboard		5.6	
Heavy oil, etc.			62.7		Pottery and glassware		5.2	
Coal, etc.			3,113.7		Metal manufactures		12.1	
Minerals and metals	...	...	...	100.5	Machinery		8.8	
Pig iron			4.5		Textile materials	...	...	14.4
Iron and steel			16.2		Cotton tissues		7.0	
Zinc			8.0		Metals and minerals	...	...	80.5
Lead			2.2		Iron and steel		27.2	
Copper			1.8		Copper		1.2	
Others			67.7		Others		52.1	
Chemical materials	...	...	...	562.9	Chemical materials	...	...	40.8
Stone and earth, mainly					Foodstuffs	...	...	24.1
natural phosphates			220.6		Sugar, refined		12.4	
Sulphur and pyrites			212.8		Fuels	...	...	76.6
Pitch, tar, etc.			20.1		Miscellaneous	...	...	168.2
Coal-tar pitch			29.0					
Nitrate of soda (natural)			20.7					
Nitrate of soda (synthetic)			15.3					
Sulphate of ammonia			15.9					
Sodium chloride			14.3					
Other chemical products			14.7					
Timber, etc.	...	...	...	403.6				
Timber			159.8					
Cellulose pulp			243.7					
Textile materials	...	...	...	7.1				
Wine	...	...	...	875.1				
Foodstuffs	...	...	...	268.5				
Cereals			129.6					
Rice			59.7					
Fruit			43.7					
Oilseeds	...	...	...	49.8				
Tobacco (leaf)	...	...	...	2.5				
Paper	...	...	...	14.7				
Miscellaneous	...	...	...	40.2				
Total: 1938				7,855.3	Total: 1938			436.3
1937				6,243.5	1937			455.7
Navigation tonnage, 1937				7,631.7	Navigation tonnage, 1937			670.3

## HAVRE

<i>Imports</i>					<i>Exports</i>				
Fuels	...	...	...	544.2	Manufactures	...	...	...	66.0
Coal, etc.			291.6		Textiles			9.0	
Petrol			0.3		Cotton		5.9		
Petroleum, etc.			28.0		Jute		1.2		
Heavy oil and petroleum					Wool		0.7		
residue			24.3		Silk and rayon		0.8		
					Linen		0.4		
					Textile yarns			3.6	
					Cotton		2.0		
					Wool		0.8		
					Rayon and silk		0.8		

HAVRE (*continued*)

<i>Imports</i>				<i>Exports</i>			
Minerals and metals	...	...	76.6	Manufactures ( <i>continued</i> )			
Iron and steel		1.2		Paper and cardboard		14.8	
Copper		52.2		Books		1.4	
Lead		8.5		Pottery and glassware		4.0	
Tin		2.9		Soaps and perfumes		1.6	
Zinc		3.5		Dyes and colours		4.1	
Nickel		5.4		Metal manufactures		9.2	
Others		2.9		Machines and machine parts		6.8	
Chemical materials	...	...	26.7	Boilers		0.5	
Stone and earth		10.1		Vehicles, except auto-mobiles		0.5	
Graphite and plumbago		1.3		Automobiles		1.3	
Bismuth		0.2		Ships		4.8	
Borates		2.2		Other manufactures		4.4	
Sodium chloride		1.2		Textile materials	...	...	18.8
Coal-tar pitch		7.7		Wool		0.1	
Dyes		0.2		Cotton		2.2	
Others		3.8		Rags		16.3	
Timber, etc.	...	...	179.5	Others		0.2	
Common timber		133.4		Metals and minerals	...	...	23.6
Exotic wood		36.4		Iron and steel		13.0	
Cellulose pulp		9.7		Aluminium in ingots		5.1	
Textile materials	...	...	186.9	Ferro-alloys		1.2	
Wool		0.5		Antimony		0.8	
Cotton		162.3		Copper		2.8	
Linen		0.5		Nickel		0.6	
Hemp		0.7		Zinc		0.1	
Jute		1.2		Chemical materials	...	...	19.6
Others		8.4		Stone and earth		4.3	
Jute tissues		4.7		Graphite and plumbago		0.2	
Esparto, coconut, etc.		6.9		Phosphatic fertilizers		4.3	
Animal hair		0.9		Sulphate and potash		1.6	
Rags		0.9		Others		9.2	
Rubber and gutta percha	...	...	25.0	Wine and spirits, etc.	...	...	11.5
Wine, etc.	...	...	56.6	Wine		6.9	
Wine		32.4		Spirits		0.4	
Spirits		24.2		Liqueurs		1.0	
Foodstuffs	...	...	442.8	Beer and mineral waters		3.2	
Meat		11.3		Foodstuffs	...	...	17.3
Dried fish		5.0		Cereals		6.6	
Grain, flour, etc.		83.6		Rice		3.6	
Sago, etc.		12.0		Cheese		1.9	
Rice		69.7		Sugar and sugar preparations		0.4	
Fruit		98.4		Others		4.8	
Raw sugar		1.3		Fuels	...	...	28.0
Molasses		1.1		Heavy oil and petroleum residues		27.3	
Coffee		113.3		Petroleum		0.3	
Cacao		16.5		Coal, etc.		0.4	
Others		30.6		Timber	...	...	9.9
Oilseeds, etc.	...	...	68.7	Common timber		7.5	
Machines and machine parts	...	...	6.0	Exotic woods		2.4	
Metal manufactures	...	...	1.3	Miscellaneous	...	...	44.8
Automobiles	...	...	3.6	Total: 1938			239.5
Miscellaneous	...	...	78.6	1937			237.4
Total: 1938			1,696.6	Navigation tonnage, 1937			795.0
1937			2,082.2				
Navigation tonnage, 1937			4,497.7				



## BORDEAUX AND SUBSIDIARY PORTS

<i>Imports</i>					<i>Exports</i>				
Fuels	...	...	...	1,833.4	Manufactures	...	...	...	49.2
Coal, etc.			1,007.0		Textiles			1.1	
Petroleum			812.3		Soap and perfumes			1.1	
Minerals and metals	...	...		35.9	Dyes			9.9	
Copper			5.1		Pottery and glassware			8.1	
Tin			0.5		Paper and cardboard			10.6	
Lead			1.4		Machines and machine parts			3.3	
Others			28.7		Boilers			0.2	
Chemical materials	...	...		206.8	Vehicles, except auto-mobiles			0.5	
Sulphur and pyrites			71.6		Automobiles			0.4	
Stone and earth, mainly natural phosphates			69.3		Ships			0.7	
Coal-tar pitch			24.2		Other metal manufactures			6.8	
Nitrate of soda (natural)			10.1		Other manufactures			6.3	
Nitrate of soda (synthetic)			6.6		Metals and minerals	...	...		47.4
Sodium chlorate			11.3		Iron and steel			27.7	
Copper sulphate			9.2		Pig iron			0.8	
Others			4.5		Copper			0.8	
Timber, etc.	...	...		53.8	Others			18.1	
Common timber			30.1		Chemical products...	...	...		21.6
Exotic			0.5		Sulphur			14.2	
Cellulose pulp			23.1		Wine and spirits, etc.	...	...		48.6
Textile materials	...	...		44.0	Wine			38.4	
Wool and waste			24.7		Foodstuffs	...	...		48.7
Cotton			2.6		Dried fish			7.3	
Jute			1.5		Cereals, etc.			5.3	
Phormium			2.0		Fruit			7.1	
Rags			9.0		Sugar, crude or refined and preparations thereof			1.3	
Others			4.2		Others			27.7	
Textiles	...	...		3.0	Textile materials	...	...		8.1
Jute tissues			2.9		Wool and waste			8.0	
Rubber	...	...		2.2	Fuels	...	...		28.1
Vegetable oils	...	...		1.5	Heavy oil and petroleum residues			18.0	
Oilseeds	...	...		170.1	Petroleum and petroleum products			6.8	
Wine and spirits	...	...		56.7	Timber	...	...		299.7
Wine			39.5		Miscellaneous, incl.:	...	...		76.5
Foodstuffs	...	...		303.5	Resins, gums, etc.			35.9	
Fish			10.4		Cellulose			1.1	
Grain, etc.			94.2						
Rice			66.4						
Fruit			29.3						
Coffee			9.6						
Cacao			3.6						
Miscellaneous, incl.:	...	...		42.6					
Tobacco (leaf)			3.4						
Paper			2.6						
Rubber			2.2						
Tar, bitumen and asphalt			17.8						
Total: 1938				2,753.5	Total: 1938				642.0
1937				3,251.5	1937				735.2
Navigation tonnage, 1927				3,461.0	Navigation tonnage, 1937				1,015.8

## DUNKIRK

<i>Imports</i>					<i>Exports</i>				
Fuels ... ..	...	...	...	534.1	Manufactures ... ..	...	...	...	161.0
Petroleum, etc.			421.1		Textiles			15.0	
Heavy oil and petroleum residue			17.7		Jute		6.7		
Coal, etc.			95.3		Cotton		5.2		
Minerals and metals ... ..	...	...	...	300.1	Wool		1.4		
Pig iron			1.7		Silk, rayon, etc.		0.4		
Iron and steel			1.6		Others		1.3		
Copper			0.6		Metal manufactures ... ..	...	102.8		
Lead			3.8		Machinery and boilers		15.9		
Zinc			1.2		Other metal manufactures		86.9		
Others			291.2		Soaps and perfumes		0.8		
Chemical materials ... ..	...	...	...	368.6	Dyes		1.9		
Sulphur and pyrites			164.2		Pottery and glassware		23.8		
Stone and earth, mainly natural phosphates			100.0		Paper and cardboard		6.0		
Nitrate of soda (natural)			39.5		Vehicles, except auto-mobiles		4.4		
Nitrate of soda (synthetic)			32.7		Automobiles		0.4		
Coal-tar pitch			4.4		Ships		2.9		
Others			27.8		Miscellaneous manufactures		3.0		
Timber, etc. ... ..	...	...	...	37.4	Metals and minerals ... ..	...	...	...	302.2
Timber			36.6		Iron and steel		254.7		
Textile materials ... ..	...	...	...	278.2	Pig iron		45.8		
Wool			139.2		Copper		0.6		
Cotton			90.5		Zinc		0.7		
Jute			35.2		Ferro-alloys		0.4		
Jute tissues			3.5		Chemical materials ... ..	...	...	...	72.7
Rags			2.0		Phosphatic fertilizers		25.9		
Others			7.8		Tar, bitumen and asphalt		0.3		
Wine and spirits ... ..	...	...	...	155.1	Sulphate of ammonia		3.8		
Foodstuffs ... ..	...	...	...	421.7	Others		42.7		
Grain, etc.			262.8		Foodstuffs ... ..	...	...	...	92.1
Rice			91.4		Sugar and sugar preparations		55.5		
Other cereals			20.9		Fuels ... ..	...	...	...	135.9
Fruit			18.6		Petroleum, etc.		47.1		
Coffee			3.3		Heavy oil, etc.		56.4		
Other foodstuffs			24.7		Coal, etc.		32.4		
Oilseeds ... ..	...	...	...	307.1	Textile materials ... ..	...	...	...	4.5
Miscellaneous ... ..	...	...	...	69.1	Wool		1.4		
					Cotton		0.6		
					Jute		0.4		
					Rags		2.1		
					Miscellaneous ... ..	...	...	...	190.0
Total: 1938				2,471.4	Total: 1938				958.5
1937				2,725.3	1937				931.2
Navigation tonnage, 1937				2,995.8	Navigation tonnage, 1937				1,032.2



## NANTES AND ESTUARY PORTS

<i>Imports</i>					<i>Exports</i>				
Fuels ... ..	...	...	...	707.4	Manufactures ... ..	...	...	...	11.6
Coal, etc.			706.2		Textiles			0.6	
Petroleum			1.2		Soaps and perfumes			1.5	
Minerals and metals ... ..	...	...	...	20.4	Pottery and glassware			1.4	
Copper			0.4		Paper			0.9	
Lead			1.9		Machines and machine parts			0.7	
Tin			1.2		Boilers			0.2	
Zinc			0.1		Metal manufactures			4.4	
Antimony			2.0		Wood manufacturers			0.4	
Coal tar			14.8		Ships			0.8	
Chemical materials ... ..	...	...	...	177.8	Rope and twine			0.7	
Sulphur and pyrites			43.3		Metals and minerals ... ..	...	...	...	382.8
Ammonium sulphate			3.5		Iron and steel			2.3	
Copper sulphate			2.7		Copper			3.6	
Coal-tar pitch			21.2		Others			376.9	
Stone and earth for art and trade, mainly natural phosphates			106.0		Chemical products... ..	...	...	...	0.7
Timber, etc. ... ..	...	...	...	12.9	Phosphatic fertilizers			0.4	
Common timber			8.0		Glycerine			0.7	
Cellulose pulp			4.9		Other chemical products			0.3	
Textile materials ... ..	...	...	...	5.6	Wine and spirits, etc. ... ..	...	...	...	1.9
Hemp			0.9		Wine			0.8	
Phormium			2.3		Foodstuffs ... ..	...	...	...	20.9
Jute tissues			1.2		Sugar, etc.			7.3	
Rags			1.0		Potatoes			7.9	
Others			0.2		Dried fish			1.6	
Rubber ... ..	...	...	...	0.2	Cereals, flour, etc.			2.2	
Wine, etc. ... ..	...	...	...	98.0	Others			1.9	
Wine			97.7		Fuels ... ..	...	...	...	0.7
Foodstuffs ... ..	...	...	...	199.2	Coal, etc.			0.7	
Grain, etc.			14.1		Timber ... ..	...	...	...	1.8
Sago, tapioca, etc.			8.5		Miscellaneous ... ..	...	...	...	3.8
Rice			82.5						
Fruit			21.6						
Sugar and molasses			68.0						
Coffee			1.3						
Cacao			0.5						
Others			0.5						
Oilseeds, etc. ... ..	...	...	...	4.1					
Oilseeds			2.0						
Olive oil			1.0						
Oilcake			1.1						
Manufactures ... ..	...	...	...	3.6					
Paper			3.0						
Miscellaneous ... ..	...	...	...	24.6					
Total: 1938				1,249.2	Total: 1938				423.5
1937				1,553.6	1937				517.8
Navigation tonnage, 1937				2,097.5	Navigation tonnage, 1937				605.2

## ST NAZAIRE

<i>Imports</i>				<i>Exports</i>			
Fuels ... ..	...	...	243·7	Manufactures ... ..	...	...	0·1
Coal, etc.	...	243·3		Soaps and perfumes	...	0·02	
Heavy oil	...	0·3		Glassware	...	0·02	
Minerals and metals ... ..	...	...	0·3	Paper	...	0·01	
Iron and steel	...	0·2		Machines	...	0·02	
Chemical materials ... ..	...	...	4·6	Machine parts	...	0·04	
Coal-tar pitch	...	4·6		Fuels ... ..	...	...	0·2
Timber ... ..	...	...	1·4	Heavy oil	...	0·20	
Common timber	...	1·2		Metals and minerals ... ..	...	...	14·7
Textile materials ... ..	...	...	1·3	Iron and steel	...	0·46	
Jute	...	0·4		Others	...	10·1	
Others	...	0·8		Wine and spirits, etc.	...	...	0·1
Wine, etc. ... ..	...	...	15·3	Foodstuffs ... ..	...	...	0·1
Foodstuffs ... ..	...	...	1·8	Butter	...	0·1	
Dried fish	...	0·5		Timber ... ..	...	...	0·5
Other fish	...	1·0		Textile materials ... ..	...	...	0·5
Miscellaneous ... ..	...	...	4·1	Rags	...	0·5	
Tobacco	...	1·8		Miscellaneous ... ..	...	...	1·1
Manufactures	...	1·9		Total: 1938	...	...	17·3
Total: 1938	...	...	272·5	1937	...	...	20·2
1937	...	...	438·8	Navigation tonnage, 1937	...	...	25·9
Navigation tonnage, 1937	...	...	437·9				

## SETE

<i>Imports</i>				<i>Exports</i>			
Fuels ... ..	...	...	57·3	Manufactures ... ..	...	...	2·5
Coal, etc.	...	56·2		Paper	...	0·5	
Petroleum	...	0·5		Machinery, metal manu- factures	...	1·0	
Heavy oil	...	0·6		Other manufactures	...	1·0	
Minerals and metals ... ..	...	...	6·5	Fuels ... ..	...	...	2·0
Chemical materials ... ..	...	...	283·9	Coal	...	1·9	
Coal-tar pitch	...	146·4		Metals and minerals ... ..	...	...	62·5
Sulphur	...	74·8		Iron and steel	...	5·6	
Stone and earth, mainly natural phosphates	...	51·5		Zinc	...	2·1	
Others	...	11·2		Others	...	54·8	
Timber ... ..	...	...	10·3	Tar, bitumen and asphalt	...	...	22·6
Common	...	6·2		Stone and earth ... ..	...	...	1·2
Exotic	...	4·1		Phosphatic fertilizers	...	...	24·0
Textile materials ... ..	...	...	8·9	Chemical products... ..	...	...	18·4
Wool	...	8·2		Ammonium sulphate	...	4·7	
Wine ... ..	...	...	293·5	Sulphur	...	1·7	
Foodstuffs ... ..	...	...	78·4	Others	...	12·0	
Fruit	...	31·4		Wine and spirits ... ..	...	...	2·6
Wheat, etc.	...	24·0		Wine	...	1·5	
Others	...	23·0		Miscellaneous ... ..	...	...	9·7
Miscellaneous ... ..	...	...	10·2	Total: 1938	...	...	145·5
Total: 1938	...	...	749·0	1937	...	...	133·4
1937	...	...	709·2	Navigation tonnage, 1937	...	...	189·5
Navigation tonnage, 1937	...	...	962·1				



## LA PALLICE

<i>Imports</i>					<i>Exports</i>				
Fuels	...	...	...	224.5	Manufactures	...	...	...	1.4
Coal, etc.			206.7		Metals and minerals	...	...	...	16.2
Petroleum			14.0		Iron ore			15.0	
Heavy oil, etc.			3.8		Zinc ore			0.8	
Minerals	...	...	...	28.4	Iron and steel			0.4	
Chemical materials	...	...	...	13.4	Wine and spirits	...	...	...	5.8
Ammonium sulphate			12.7		Spirits			5.1	
Copper sulphate			0.7		Timber	...	...	...	7.6
Stone and earth, mainly natural phosphates...			...	64.7	Common timber			7.4	
Sulphur and pyrites	...	...	...	19.8	Organic fertilizers				3.3
Coal-tar pitch	...	...	...	7.2	Careine				4.0
Nitrate of soda	...	...	...	29.4	Miscellaneous	...	...	...	5.6
Natural			13.5						
Synthetic			15.9						
Timber, etc.	...	...	...	11.3					
Common timber			10.0						
Cellulose pulp			1.3						
Textile materials	...	...	...	3.8					
Raw jute			2.1						
Jute yarns			1.1						
Wine, etc.	...	...	...	21.0					
Wine			17.6						
Foodstuffs	...	...	...	104.2					
Cereals			26.4						
Rice			74.2						
Miscellaneous	...	...	...	1.6					
Total: 1938				529.3	Total: 1938				39.9
1937				000.0	1937				00.0
Navigation tonnage, 1937				553.9	Navigation tonnage, 1937				72.1

## LA ROCHELLE

<i>Imports</i>					<i>Exports</i>				
Coal, etc.	...	...	...	188.5					
Coal-tar pitch	...	...	...	6.9					
Common timber	...	...	...	4.7					
Ships	...	...	...	3.5					
Miscellaneous	...	...	...	2.4					
Total: 1938				204.8	Total: 1938				0.08
1937				000.0	1937				0.00
Navigation tonnage, 1937				263.9	Navigation tonnage, 1937				72.1

## BOULOGNE

<i>Imports</i>					<i>Exports</i>				
Fuels ... ..	...	...	...	302.7	Stone ... ..	...	...	...	16.1
Coal, etc.			300.6		Fruit ... ..	...	...	...	5.5
Petrol			2.1		Vegetables ... ..	...	...	...	1.2
Minerals, unspecified	...	...	...	82.6	Wine and mineral waters	...	...	...	4.6
Stone, mainly phosphates...	...	...	...	1.6	Textile materials	...	...	...	4.5
Timber ... ..	...	...	...	7.8	Wool and waste			2.9	
Textile materials	...	...	...	25.6	Others			1.6	
Jute			22.9		Sulphate of ammonia	...	...	...	3.1
Wool			1.6		Iron and steel	...	...	...	2.8
Others			1.1		Miscellaneous	...	...	...	65.7
Foodstuffs ... ..	...	...	...	9.1					
Fresh fish			6.7						
Dried fish			1.5						
Other fish			0.4						
Other foodstuffs			0.4						
Wine ... ..	...	...	...	11.3					
Miscellaneous	...	...	...	19.0					
Total: 1938				451.9	Total: 1938				103.5
1937				493.6	1937				131.6
Navigation tonnage, 1937				534.4	Navigation tonnage, 1937				366.1

## CALAIS

<i>Imports</i>					<i>Exports</i>				
Fuels ... ..	...	...	...	20.2	Manufactured goods	...	...	...	0.8
Coal, etc.			20.2		Textiles			0.63	
Minerals and metals	...	...	...	187.1	Cotton		0.51		
Pig iron			0.8		Silk, rayon, etc.		0.12		
Lead			0.3		Machine parts			0.2	
Others			186.0		Wine ... ..	...	...	...	1.1
Chemical materials	...	...	...	42.8	Miscellaneous	...	...	...	26.9
Sulphur and pyrites			8.5						
Sodium chlorate			8.0						
Nitrate of soda (natural)			6.4						
Nitrate of soda (artificial)			2.8						
Coal-tar pitch			10.4						
Timber, etc. ... ..	...	...	...	261.3					
Common timber			211.6						
Cellulose pulp			49.7						
Wine ... ..	...	...	...	5.7					
Miscellaneous	...	...	...	2.3					
Total: 1938				519.4	Total: 1938				28.8
1937				670.6	1937				17.7
Navigation tonnage, 1937				652.9	Navigation tonnage, 1937				29.0



## BAYONNE

<i>Imports</i>				<i>Exports</i>			
Fuels	...	...	...	327.2	Iron ore	...	20.1
Coal, etc.		323.3			Wine	...	0.08
Petroleum products		3.9			Coal...	...	0.08
Minerals and metals	...	...	46.9		Timber	...	85.9
Iron ore		25.2			Vegetable, gums and resins	...	8.0
Others		21.7			Miscellaneous	...	0.63
Chemical materials	...	...	33.8		Cork	...	0.16
Stone and earth, mainly natural phosphates		23.2					
Sulphur and pyrites		9.2					
Others		1.4					
Timber	...	...	3.4				
Textile materials	...	...	0.4				
Wine	...	...	10.3				
Miscellaneous	...	...	20.2				
Total: 1938			442.2	Total: 1938			114.8
1937			535.5	1937			101.4
Navigation tonnage, 1937			567.9	Navigation tonnage, 1937			126.3

## DIEPPE

<i>Imports</i>				<i>Exports</i>			
Fuels	...	...	209.1	Stone (mainly flint and shingle)	...		5.5
Coal and coke		208.0		Hay and fodder	...		4.1
Heavy oil		1.1		Cereals	...		7.9
Chemical materials	...	...	27.6	Timber	...		2.6
Coal-tar pitch		4.8		Raw wool	...		2.5
Phosphates		6.5		Wine	...		1.0
Nitrates, natural and synthetic		9.2		Metals and manufactures thereof			3.1
Sulphur and pyrites		5.2		Paper and cardboard	...		1.4
Chemical fertilizers		1.1		Miscellaneous	...		12.2
Other chemical materials		0.8					
Timber	...	...	1.8				
Textile materials	...	...	3.2				
Jute, raw and manu- factured		2.3					
Wool		0.7					
Others		0.2					
Oilseeds	...	...	53.0				
Fruit (mainly bananas)	...	...	57.1				
Cereals	...	...	2.5				
Fish...	...	...	2.1				
Miscellaneous	...	...	4.8				
Total: 1938			361.2	Total: 1938			40.3
1937			474.3	1937			36.8
Navigation tonnage, 1937			442.1	Navigation tonnage, 1937			111.2

## NICE

<i>Imports</i>					<i>Exports</i>				
Coal...	...	...	...	137.2	Iron and steel	...	...	...	16.5
Coal-tar pitch	...	...	...	2.5	Vegetable oils	...	...	...	5.7
Timber	...	...	...	2.0	Miscellaneous	...	...	...	53.2
Foodstuffs	...	...	...	30.2					
Cereals			26.5						
Wine	...	...	...	18.2					
Olive oil	...	...	...	12.1					
Miscellaneous	...	...	...	41.7					
Total: 1938				243.9	Total: 1938				75.4
1937				291.1	1937				40.8
Navigation tonnage, 1937				248.7	Navigation tonnage, 1937				37.6

## COASTING TRADE

It will have been observed that in many French ports the coasting trade accounts for a considerable movement of cargo. This trade showed a steady progress in the ten years 1928-38. In 1937, 39,326 vessels of 7,826,073 gross tons were employed, in both the *Grand Cabotage*, or trade between Mediterranean ports and Atlantic or Channel ports, and in the *Petit Cabotage*, or trade confined to one coast:

Grand Cabotage	187 ships	378,166 gross tons
Petit Cabotage	39,139 ships	7,447,907 gross tons
	<u>39,326 ships</u>	<u>7,826,073 gross tons</u>

In 1937 just over 5 million tons of cargo were carried coastwise, of which the great bulk made comparatively short journeys on one coast or in one estuary. Some coastwise cargo is handled by every port, many of the smaller ports having no foreign trade, yet in spite of this, over three-fifths of the coastal traffic as a whole is concentrated in four main groups of ports: those of the Seine, the Loire and the Gironde estuaries, and Marseilles-Bouc. The remaining eighteen principal ports together handle only just over 1 million tons, or one-fifth of the total, while all the minor ports and the very small harbours handled only one-tenth. Among these eighteen ports, too, the trade is unevenly distributed, for Dunkirk, Boulogne, Caen, Brest and St Louis-du-Rhône account for a great proportion of the total. The first two have a large outward traffic, for Dunkirk exports coal and gasoline coastwise and Boulogne cement.



*Coastwise Cargo Movements*

	Inwards	Outwards
Marseilles—Bouc, Berre	435·8	753·2
Havre, Rouen and Seine ports	1,537·4	1,947·1
Nantes, St Nazaire and Loire ports	402·5	351·9
Bordeaux and Gironde ports	734·7	709·4
	<hr/> 3,110·4	<hr/> 3,761·6
Eighteen other principal ports	1,382·6	1,033·2
Minor ports	288·0	249·6
Small harbours	188·8	80·0
	<hr/> 4,969·8	<hr/> 5,124·4

It will be observed that the Seine and Marseilles-Bouc groups have a considerable outward balance of cargo, whereas all the remaining ports have an equivalent inward balance, indicating that the two leading groups distribute cargo in excess of that which they receive. A very great part of the coastwise trade, however, is confined within the estuaries of the Seine, Loire and Gironde and the Berre-Marseilles coast. The enormous coastwise import of 1,195,000 tons at Rouen is comprised mainly of 570,000 tons imported from Havre and 468,000 from Port-Jérôme, the greater part consisting of petroleum from Havre and refined petroleum products from both Havre and Port-Jérôme. Similarly, Nantes receives refined petroleum products from Donges, Bordeaux from Pauillac and Bec d'Ambes, and Marseilles from the Berre ports.

Petroleum and its derivatives, in fact, make up nearly one-half of all the coastwise cargoes. Other import commodities are building materials, coal, stone, phosphates, grain, rice, and iron and steel; together with petroleum and gasoline they account for four-fifths of the total.

*Principal Commodities entering into Coastwise Traffic, 1937*

(Thousands of metric tons)

Petroleum and derivatives, together with coal-tar pitch	2,253·4
Building materials	555·9
Coal and coke	264·6
Stone, earth, etc.	254·5
Grain and flour	225·9
Stone and earth for art and trade (largely phosphates)	190·5
Iron and steel	168·9
Rice	104·6

Other commodities include wine, metals, oilseeds, chemicals and

timber. The importance of petroleum, etc. in providing cargo for the coastal trade can be seen in the following table.

*Tonnage of Cargo handled*

(Thousands of metric tons)

	1928	1930	1932	1933
Total	2,532.8	2,689.8	3,553.7	3,931.6
Petroleum, etc.	329.3	448.8	661.6	830.1
	1934	1935	1936	1937
Total	5,001.7	5,624.1	5,705.5	5,124.0
Petroleum, etc.	1,588.2	2,189.9	2,091.7	2,253.4



## Chapter IV

### RAILWAYS

Introduction: Historical Background: Geographical Description: Northern Region: Eastern Region: South-eastern Region: South-western Region: Western Region: Secondary Lines: Railcar and Road Services: Railways in the Paris Area: The Vichy Regime: Bibliographical Note

#### INTRODUCTION

France possesses about 44,000 km. (26,000 miles) of railways. This represents 1 mile of railway for every 7·87 sq. miles of territory (cf. Great Britain 4·43 sq. miles, Belgium 1·66, Germany 4·29, Spain 18·90), or 1 mile of railway to 1,555 inhabitants (cf. Great Britain 2,291 inhabitants, Belgium 1,186, Germany 1,646, Spain 2,427). These mileage figures, however, refer only to the system known as 'd'intérêt général'; there are, in addition, about 20,000 km. (12,500 miles) of light railways and tramways which are classed as 'd'intérêt local'. The inclusion of these in the total would give 1 mile of railways for every 5·52 sq. miles of territory and for every 1,088 inhabitants.

#### HISTORICAL BACKGROUND

To a much greater extent than in Britain, systematic planning, with state regulation and aid, have influenced French railway development. The haphazard and relatively unrestricted growth by private enterprise which characterized the history of British railways has been almost absent from France since the very early years, whilst the regional grouping of the main-line companies, by confining each system to a definite and compact area of country, has resulted in the absence of that multiplicity of competitive services between important centres which has always been such a prominent feature of British railway working.

(a) 1822-42. The first railway in France was a horse railroad, authorized in 1822 and opened in 1828, from St Etienne to Andrézieux, on the river Loire, built to provide an outlet for the St Etienne coal-field by an engineer whose technical knowledge was gained in the Newcastle area of England. The next two lines were in effect simply extensions of this, from St Etienne to Lyons and from Andrézieux to Roanne—making 136 km. in all—whilst a fourth line of 28 km. linked

Epinac, on the Creusot coalfield, with the Bungundy Canal. Thus, as in Britain, the earliest lines were all associated with coal traffic. Locomotives and passengers made their first appearance, on the St Etienne-Lyons line, in 1832. Again, as in Britain, the capital city was not far behind in taking an interest in railways. In 1833 the Minister of Public Works took the initiative and set up a commission to study possible routes for railways from Paris to the frontiers, and sent representatives on study-tours in England and the United States. The granting of limited concessions to private companies followed, and much British capital and engineering skill began to flow into France. By 1841, 804 km. of line had been authorized, of which 569 km. were in operation, including lines from Paris to Le Pecq (on the Seine) and to Versailles, and from Strasbourg to Basle.

(b) 1842-59. In 1842 a new era dawned. A law was passed formulating a grandiose plan for a national railway system consisting of nine main lines, seven of which were to radiate from Paris—to Strasbourg, Marseilles, Toulouse, Bayonne, Nantes, Havre and Lille—with two cross-country routes, one from Bordeaux to Marseilles and the other from Dijon to Mulhouse. The state undertook to acquire the necessary land and to build the 'infrastructure', i.e. the road-bed, with its cuttings, embankments and bridges, whilst the concessionaires were to provide the rails and equipment and to operate the lines. It was under this law and those of 1845-6 relating to the exploitation of the railways that the skeleton of the French main-line network came into being, and most of what may be described as the geographically obvious lines were built. By 1847, 1,832 km. were in operation, including the main lines from Paris to Havre, Tours and Bourges. In that year 12.8 million passengers were carried and 3.6 million tons of freight, the receipts from which were roughly equal. The railway had succeeded in capturing popular as well as political imagination, and over thirty companies came into being in various parts of the country. Industrial concentration commenced, as on the northern coalfield and at St Etienne and Le Creusot. The financial crisis of 1847 and the Revolution of the following year only temporarily interrupted the spate of building, and by 1855 (see Fig. 65) the whole of the 1842 plan and a good deal more had been completed. The position in the early 'fifties was far from satisfactory, however; there were too many individual companies, and their finances were in a poor state owing to the enormous expenditure upon building and to the necessity of making provision for the return of the concession to the state after a period which averaged only about 40 years.



Accordingly, between 1852 and 1857, by a series of compulsory amalgamations, some 15,000 km. of line—only about half of it actually in operation—was divided between six main-line companies, the Nord, Est, Paris-Orléans (P.O.), Midi, Ouest, and Paris-Lyon-Méditerranée (P.L.M.), each with a 99 years' concession. Even this measure, however, did not solve the problem of providing financial means for the construction of new lines. The railway companies had already spent 3,200 million francs, and the state 775 million francs, in constructing and equipping nearly 9,000 km. of line, approximately 450,000 francs per km. The Convention of 1859 therefore introduced the principle of 'guaranteed interest', which remained the keystone of state financial policy regarding railways until 1921. On the capital raised for building some 8,000 km. of new lines, the 'nouveau réseau', the state undertook to guarantee interest at 4 % if the lines themselves did not earn enough to produce such a dividend, whilst the excess profits (above a certain limit) earned by the already existing lines, the 'ancien réseau', were to be devoted to the repayment of this guarantee. This system remained in force until 1883, and it is worth noting that of the six companies, only the Nord, with its coal and heavy industrial traffic, and the P.L.M., which served a more varied territory than any other company, including Marseilles and Switzerland, were never under the necessity of calling on the state guarantee. Of the other main-line companies, the Ouest, P.O. and Midi served almost entirely agricultural areas, whilst the Est was cut off by the Franco-Prussian war of 1870-1 from the bulk of the Lorraine ironfield.

(c) 1859-82. The work of creating a secondary network to serve the areas in between the main trunk lines proceeded rapidly under the new law, and some new principles were introduced in the 'sixties. In 1863-4 the state subsidized the formation of several small companies, mainly in rural areas where traffic was unlikely to prove heavy, e.g. the Charentes, Vendée, Dombes and Orléans-Châlons railways, and in 1865 the first concession was granted for a 'chemin de fer d'intérêt local', a new class of line, generally of the 'light-railway' type, of inexpensive construction, to be built either by the departments and communes or by private companies. Thus by the end of 1870 the authorized length of the 'intérêt général' lines had risen to 23,439 km.; whilst 1,815 km. of 'intérêt local' lines had been built and 240 km. of purely industrial lines (mainly in the northern coalfield). Of this total 17,924 km. were in active operation.

The war of 1870-1 had an immediate effect in the loss of 840 km. of the Est line in Alsace-Lorraine to Germany, but the post-war

depression produced a serious financial situation which led ultimately to the formation of a new relationship between the state and the railways. The virtual insolvency of some of the secondary companies led the government in 1878 to purchase several of them (the Charentes, Vendée, Bressuire-Poitiers, etc.), thus creating a state-owned 'system'



Fig. 65. The growth of the French railway system

Based on a map in *Révue Générale des Chemins de Fer*, special number, May-June 1937 (Paris).

in the west and south-west of the country, comprising 2,615 km. of built or authorized line, which became known as the 'Etat' line. Yet despite the poor financial prospects of railways in the rural areas of France, the government deemed it advisable in the national interest to encourage the formation of a tertiary network to serve those areas which were still remote from the main or secondary lines (see Fig. 66).



The 'Freycinet Plan' of 1878 visualized some 10,000 km. of new lines, to be built during the ensuing decade, and as the main-line companies hesitated to undertake such a large and possibly unprofitable task the state, under the law of 1879, undertook to build 181 new lines totalling 8,848 km. The main-line companies were relatively prosperous in 1879-81, but the financial crisis of 1882 forced upon an already overburdened government the necessity for a revision of the legal and financial position.

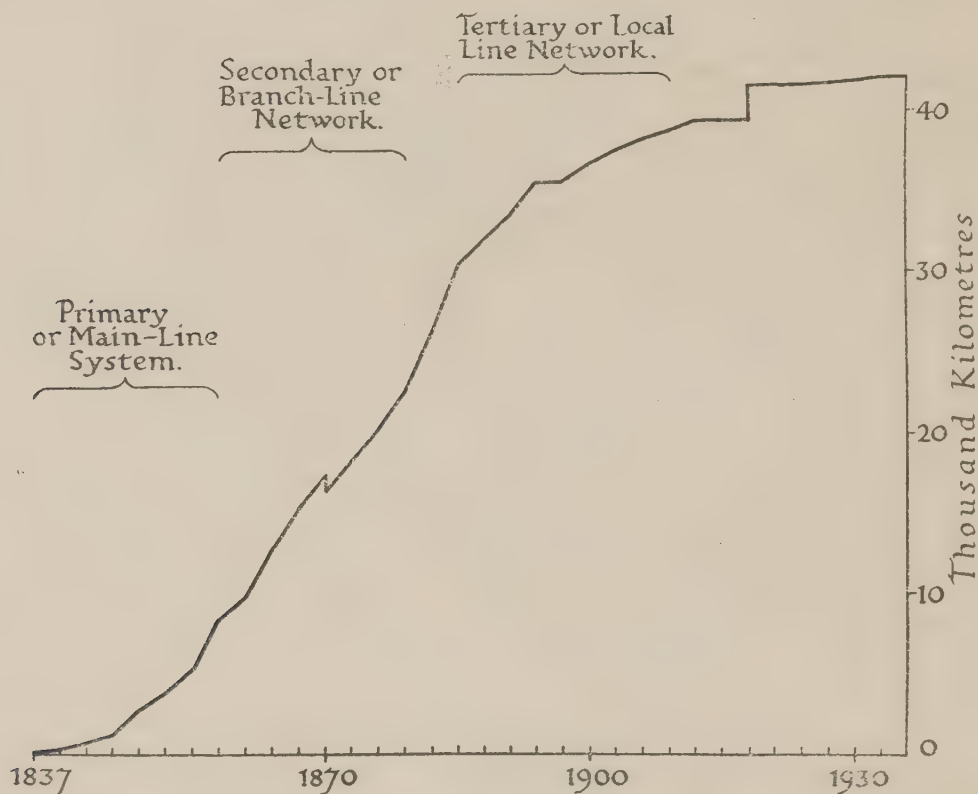


Fig. 66. Graph showing length of line opened, 1837-1936

The two interruptions represent the loss of territory and lines in Alsace-Lorraine in 1871 and their recovery in 1919, since when new construction has been almost at a standstill.

(d) 1883-1921. By the Convention of 1883, 11,485 km. of line, built or authorized, was handed over by the state to the six main-line companies, and the state guarantee of interest was extended to the whole of the railway capital, the distinction between 'ancien réseau' and 'nouveau réseau', established by the 1859 law, being dropped. Thus the state and the railway companies became more closely allied than ever, and this relationship worked well, on the whole, for 30 years, only being upset by the circumstances resulting from the war of 1914-18. The companies, for their part, agreed to help in the raising of capital for new construction and to equip and operate the new lines.

The state reserved the right to take over an unproductive line rather than continue to pay its guaranteed interest, and under this arrangement the poverty-stricken Ouest line, which in 1907 owed the government 396 million francs, a sum which was greater than the value of all its rolling stock, was absorbed into the Etat system in 1908. The rising tide of indebtedness to the state—the railway companies owed 1,208 million francs in 1908—led to several agitations for a policy of complete nationalization, but none of these was successful. The example provided by the Etat line was hardly a good argument in favour of such a policy; its exploitation coefficient, i.e. relation of expenditure to receipts, was easily the highest of any of the main-line companies, and in 1902 its deficit actually reached 5,570 francs per km. of line. The main trouble, it would seem, was that by careful planning France had built up a fine and evenly spread network of railways all over the country, but the amount of passenger and freight traffic available was not, over very large areas, sufficient to yield an adequate revenue.

During the war of 1914–18 the railways passed into the control of the Ministry of Public Works. With the aid of much British and later American equipment and rolling stock they performed prodigious feats of military transport, often under difficult circumstances. The Nord alone transported 60 million soldiers during the four years. Many new light railways—‘Décauville lines’—were built in the battle zone, some with material torn up from some of the less profitable local lines in other parts of the country; few of these outlived the war period. Some 2,600 km. of line, with about 850 stations, were completely destroyed, comprising most of the lines within an area bounded by Armentières, Arras, Soissons, Reims, Conflans-Jarny and Longwy, and a few other sections in Lorraine and in Alsace.

The return to France of Alsace and Lorraine, in 1919, added some 2,000 km. of railways to the French system. By a decree of 1920 the operation of these lines was assigned to the Ministry of Public Works, and later, in 1923, the Alsace-Lorraine (A.L.) system was admitted as a state-operated line to the regime about to be described.

(e) 1921–37. There was a phenomenal rise in operating costs in 1920: fuel prices were ten times those of 1913, wages had risen 300 %, whilst the introduction of the 8 hr. day meant a large increase in personnel and so in the wage bill. The accumulated deficits of the main-line companies were as follows: Nord, 14 million francs; P.L.M., 36 million; Est, 435 million; Midi, 830 million; P.O., 1,427 million; Etat, 1,588 million. The year 1920 added another 3,000 million francs



to this total, and a reform was obviously necessary, especially in view of the vital importance of reconstructing the war-damaged lines and of repairing the neglect of four years. The Convention of 1921 reorganized once more the relationship between the state and the



Fig. 67. The standard-gauge lines of the *intérêt général* network

This map brings out the striking difference between north-eastern France, in which most of the lines are double track, and the centre and south, where only a few main lines have more than one track. This difference is essentially a reflexion of industrial and agricultural economies.

railways as regards administration and finance. For the co-ordination of rail transport in the general interest two committees were constituted, the 'conseil supérieure des chemins de fer', a state body comprising representatives of the railway boards, the employees and the Ministry of Public Works, and the 'conseil de direction', con-

sisting of three representatives from each railway company. The Minister of Public Works had to approve the recommendations of both committees, and thus the administration of transport policy was in the hands of the state. Financial solidarity was to be created through the excess profits of the more remunerative lines being used to offset



Fig. 68. The regions of the S.N.C.F.

Based on data contained in the *Indicateur Chaix*. This map gives a different indication from Fig. 67 of the significance of various lines in the network, by showing those regularly served in normal times by passenger trains classed in the time-tables as *express* or *rapide*.

the deficits produced by others. The Convention also provided that all surplus funds should revert to the Treasury, and so to prevent inefficient operation a management bonus was established.

The railways might have been expected to prosper after this, especially when it is remembered that they received large quantities of equipment and fuel as part of Germany's reparations payments.



They did so, and surpluses were actually paid into the Treasury in 1926 and 1928, but an accumulation of adverse circumstances in the early 'thirties rendered the position once more serious. Operating costs were ten times higher in 1930 than in 1913, due to higher wages, increased social charges, the high cost of fuel, and the devaluation of the franc. The great depression of the early 'thirties made matters worse, and the sharp rise in operating costs in 1936 due to the introduction of the 40 hr. week, together with the increased incidence of road competition, caused the accumulated deficit to rise to the enormous figure of 36 billion francs. To a certain extent also, no doubt, the state tax on all passenger fares and freight rates—which had been raised to 32½ % from its pre-war level of 12 % on passenger fares and from nil to between 5 and 10 % on various classes of freight rates—was responsible for the inability of the receipts to keep pace with expenditure, and it is certain that the free carriage of mails imposed a further burden on the railways. Even the very high technical efficiency of the railways as a whole could not counteract these hindrances to profit-making. The solution was obvious, and the nationalization of the railways, which had been advocated several times during the previous hundred years—in 1871, in 1906 and again in 1918—was decreed in August 1937. The agreement between the Minister of Public Works and the five main-line companies (the P.O. and Midi had been merged in 1933), the two state-owned railways, and the two Paris belt lines, applied to the 44,000 km. of 'intérêt général' lines, which were to be merged into one concern to be known as the 'Société Nationale des Chemins de Fer Français'. The S.N.C.F. acquired the assets, assumed the obligations and undertook the operation of all the lines until 1983, when they will revert to the state. The individual companies retain to a large extent their identity until their charters expire, at various dates between 1950 and 1960, 99 years after the date of granting. The Paris belt-line syndicates were liquidated immediately and the lines transferred to those of the main-line companies most concerned in their operation; the Etat and A.L. administrations were to be liquidated in 1942. The capital of the new Company is 1,419,412,000 francs, of which 51 % is held by the state and the rest by the five main-line companies.

Nationalization of the railways would be of relatively little value in itself unless it were accompanied by a policy of co-ordinating all forms of transport services, and accordingly a most important part of the Convention of 1937 was that relating to the restriction or licensing of all road transport except that of purely local function in rural

districts, and to the provisions for ensuring the maintenance of canal traffic. A supreme council was set up to deal with general transport problems.

Thus, almost a hundred years after the first real expression of railway policy in the law of 1842, the logical conclusion of the long sequence of decrees and conventions seems to have been reached.



Fig. 69. Electrified railways, and the chief generating and transformer stations

There are three sources of electric current—the Pyrenees, the Central Massif and the Alps. Electrification is notably absent from the industrial areas of the north and east, which are well served by coal supplies, and from the economically poor areas of the west where traffic would not pay for the cost of conversion to electric traction. Only sections of the S.N.C.F. are shown on this map. There are also several secondary and local lines which use electric traction, e.g. the La Mure lines (see p. 317) and the Haute-Vienne system.

### *Electrified Railways*

One-third of France's coal consumption is imported, and the average annual consumption by the railways during the years 1921–36 was



Railway	Length of line (km.)			Employees		Locomotive stock					Traffic	
						Steam			Electric	Rail-cars		
	Total	Single track	Double track	No.	No. per km.	Total	Tender	Tank				
Etat	9,581	5,371	4,210	75,563	8.2	3,390	2,776	614 <sup>1</sup>	63	427 <sup>2</sup>	176,237	29,571
A.L.	2,090	814	1,276	29,067	13.9	1,415	1,019	396 <sup>3</sup>	—	31	55,956	38,048
Nord	3,796	1,290	2,506	66,296	16.9	2,567	1,886	681	—	71	117,958	51,603
Est	4,988	758	4,159	61,030	11.9	2,377	1,912	465	—	68	81,469	45,245
P.O.	7,393	4,952	2,441	85,376	7.5	2,008	1,618	390 <sup>4</sup>	257	150 <sup>5</sup>	74,084	27,661
Midi	4,313	3,094	1,219	108,464	10.9	724	643	81	326	110 <sup>6</sup>	82,725	38,094
P.L.M.	9,949	4,988	4,961	— <sup>9</sup>	—	5,595	4,704	891 <sup>7</sup>	41	294 <sup>8</sup>	1,486	14,947
Paris	149	—	149	—	—	146	—	146	—	—	577,226	173,821
Ceintures	—	—	—	—	—	—	—	—	—	—	4,338	8,274
Total, major systems	42,259	21,267	20,921	425,796	10.2	18,222	14,558	3,664	687	1,151 <sup>10</sup>	581,564	182,096
Secondary lines*	1,687	1,593	94	3,703	2.5	212	18	194	10	36	—	—
Total, 'intérêt général'	43,946	22,860	21,015	429,499	9.8	18,434	14,576	3,858	697	1,187	—	—

\* See pp. 315-17.

<sup>1</sup> Including 46 narrow gauge.<sup>2</sup> Including 232 electric railcars.<sup>3</sup> Including 11 narrow gauge.<sup>4</sup> Including 30 narrow gauge.<sup>5</sup> Including 102 electric railcars.<sup>6</sup> Including 57 standard-gauge electric railcars and 28 narrow-gauge electric railcars.<sup>7</sup> Including 7 narrow gauge.<sup>8</sup> Including 162 narrow-gauge electric railcars.<sup>9</sup> Lines worked by Nord and Etat.<sup>10</sup> Including 391 standard-gauge electric and 190 narrow-gauge electric.

11 million tons, hence the importance of using hydro-electric power for railways. A few electric lines, totalling only 60 miles in all (e.g. some of the Etat Paris suburban lines, the P.O. from Quai d'Orsay to Juvisy, and some Midi lines in the Pyrenees) were in existence before the war of 1914-18. After the war, in 1920, a considerable programme of electrification was planned, covering 9,000 km. (5,600 miles) of line. This was suspended in 1924, though certain sections, e.g. Modane-Chambéry, Paris-Vierzon, were pushed forward to completion. A fresh start was made in 1931-2, in part as a remedy for the unemployment problem; the conversion to electric traction of some 3,500 miles of line was visualized but this was subsequently whittled down and little progress was made except by the P.O.-Midi system, where the chief work was the completion of the Paris-Hendaye line, and on the Etat, where the main line from Paris to Le Mans was electrified. By 1939, 3,310 km. (2,056 miles) of line were electrified, and in addition upwards of 500 miles of 'intérêt local' lines were electrically operated. The largest of the latter is the Haute-Vienne system, operating over 350 km. of line centring on Limoges; but the most important, undoubtedly, is the Paris Métro (see below, p. 324).

Some details of the various electrified lines are given in the sections which follow on the regions of the S.N.C.F.

## GEOGRAPHICAL DESCRIPTION

On p. 248 are presented in tabular form certain statistics relating to the French railways. The figures are for the year 1936, the latest for which published information is available; thus details for the individual companies which existed prior to the nationalization in 1938 are given.

In the following sections the five regions into which the S.N.C.F. is divided (Fig. 68) are treated separately. The main lines of each are described and illustrated in relation to the physical background of the country; notes are added on the permissible axle-loads (Fig. 70); the passenger and freight traffics are analysed; and the location of the principal engine sheds and works and of the major groups of sidings and marshalling yards are briefly described and mapped.

Some introductory notes are here appended on the two series of diagrams, the gradient profiles and the shed-and-yard maps.



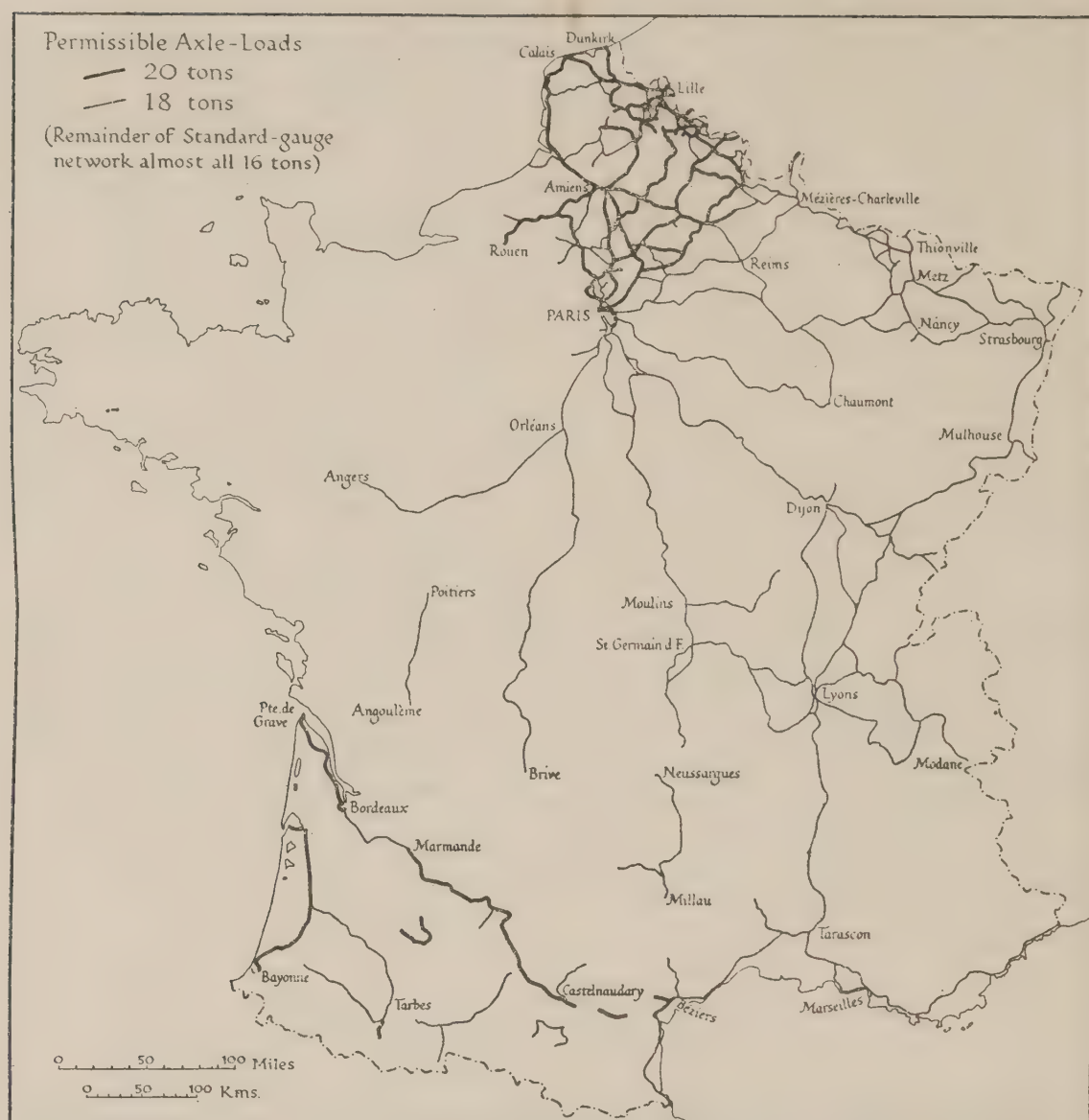


Fig. 70. Permissible axle-loads

Based on data in *Achsdruckverzeichnis* (Berlin, Verein Mitteleuropäischer Eisenbahnverwaltungen, 1938). The axle-load allowed on any line depends on the weight of the rails per unit length, on the type and spacing of the sleepers and the method of tying the rails thereto, on the nature and depth of the ballast, and above all on the strength of bridges, etc., over which the line passes. French rails are generally heavy, 44–62 kg./m. (88–124 lb./yd.), and in consequence it is the other factors which largely control the permissible load. The concentration of high axle-load in the northern region, with its heavy coal traffic, is very marked. It is noteworthy that the Nord railway was the only French line continuing to rely on six-coupled express engines (4–6–2 ‘Pacific’ type) for its passenger trains. All the other steam-operated railways have for over a decade employed eight-coupled engines (4–8–2 ‘Mountain’ type), which for an equal or greater total weight have a lighter weight on each axle (Plate 69). Compare Plate 59, and for further explanation see pp. 259, 273, 284, 301, 310. It may be noted for purposes of comparison that the standard axle-load on British main lines is 22½ tons.

*A. Gradient Profiles* (Figs. 72, 73, 74, 75, 78, 79, 80, 81, 85, 88, 89, 90, 91, 95, 96, 97)

(i) As the slopes involved are so small, very great vertical exaggeration is necessary. On these profiles the vertical scale is sixty times the horizontal, and moreover some of the profiles have been drawn higher above the 'sea-level' line than they should be, in order to allow room for the insertion of the geological information.

(ii) Owing to the large vertical exaggeration, geological dips are also grossly enlarged. Thus, gentle  $1-5^{\circ}$  dips characteristic of the scarplands become  $30^{\circ}$  on the profiles, and horizontal strata, especially if thin, have to be given an artificial dip in order to represent them at all. Moreover, the relative thickness of the geological formations as indicated on the profiles must be regarded as unreal, by reason of the gross exaggeration of the dip. A very false idea of thickness is also liable to be given when the line runs along the strike of a particular formation instead of in the direction of the dip.

(iii) The profiles are of the actual railway track and not of the land surface across which the lines are running. Consequently, since cuttings and embankments are frequent, the profiles are much smoother than those of corresponding orographical sections.

(iv) Owing to the characteristic tonguing of geological outcrops up valleys, it frequently happens that, although the profile indicates that a fresh, and older formation has been reached, when descending a valley, the valley sides will still be composed of the previous formation, the scarped edge of which may appear later. Several examples of the phenomenon are indicated, notably on the profiles of lines leading across the scarplands on the eastern side of the Paris basin.

(v) The profiles are based on diagrams in a supplement to the *Railway Gazette* dated May 21, 1937, and in a series of articles on French railways in the *Railway Magazine*. The geological information has been inserted by reference to the French geological maps on scales of 1:500,000 and 1:80,000.

*B. Sheds and Yards* (Figs. 76, 82, 86, 93, 98)

(i) In order to avoid confusion, only the more important lines within each region are indicated.

(ii) The position of the sheds and yards is approximate only, owing to the small scale of the maps; they are not necessarily on the side of the line indicated by the symbols.



(iii) The exact definition of a marshalling yard is not easy. The text refers to the largest 'hump' yards. Apart from these, those indicated on the maps have in general more than twenty sidings. Numerous yards on the frontiers of France can scarcely be called 'marshalling yards'; their main function is the accommodation of international traffic which requires to halt for customs purposes. Groups of sidings used almost entirely for the storage and marshalling of passenger coaching stock (e.g. the large yards in the Paris region at Bercy, Pantin and Le Landy) are not included.

### NORTHERN REGION

Of the seven formerly separate railways (see p. 248), the Nord possessed the shortest mileage except for the A.L. system (3,796 km.—2,365 miles—of which 2,506 km.—1,557 miles—are double track), yet its freight traffic was greater than that of any other system, and its passenger traffic second only to that of the Etat railway (which latter obtained first place largely by reason of its intensive Paris suburban traffic); moreover, the network of lines reaches a greater density in the northern region than in any other part of France (see Fig. 71). The reason is not far to seek. The line serves the greatest industrial region of the country, the northern coalfield, which it links with Paris; it links the capital with the channel ports of Boulogne, Calais and Dunkirk, and its cross-country routes, joining up with the lines of the Eastern railway at Laon and Hirson, link the channel ports with Switzerland and Germany (and so with central and south-eastern Europe generally) and the northern coalfield with the Lorraine iron-field.

The main trunk line runs northwards from Paris to Creil, whence two lines diverge, one striking north-eastwards to St Quentin and Aulnoye (for Mons and Brussels, and for Namur, Liège and Cologne), and the other northwards to Amiens, Arras, and Lille (for Ghent and Antwerp). A third main artery branches at Amiens for Boulogne and Calais, and a fourth at Arras for Dunkirk. The outermost and least important of this radiating fan of main lines run from Paris via Beauvais to the seaside resort of Le Tréport, and from Paris via Soissons and Laon to Hirson, where connexion is made with the eastern region and with the lines serving the coalfield. The main cross-country lines run from Amiens to Laon (for Nancy and Strasbourg or for Dijon and the Mediterranean), and from Calais via Hazebrouck to Lille and so through the heart of the coalfield to

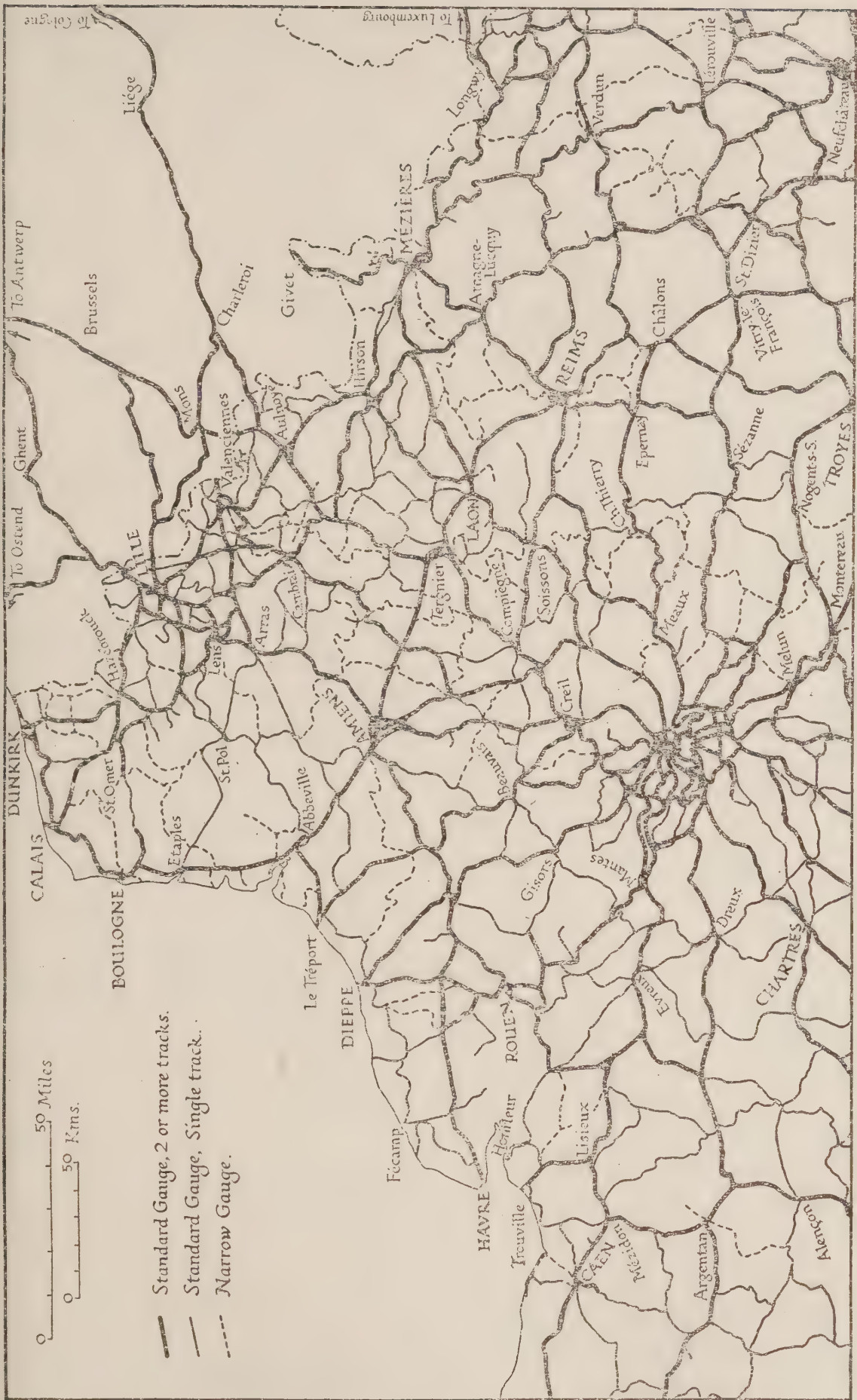


Fig. 71. Railways in northern France

This and the other maps in this series, Figs. 77, 83, 84, 87, 92, 94, 100, are based on the *Carte des Chemins de Fer Français*, in four sheets, scale 1 : 800,000, edition of December 1939 (Paris). They cover exactly the same areas as the series of physical and geological maps in Vol. I, ch. I, of this Handbook.



Valenciennes and Hirson (for Mézières and Metz). Another connexion of some importance runs from Amiens to Serqueux, where the Paris-Dieppe line of the western region is crossed, continuing thence into what is really western region territory as far as Rouen, where further connexions with the western lines are made.

(i) *Paris-Maubeuge (for Liège)* (Fig. 73)

*Summary*

- (1) Length: 239 km. (148 miles) to Belgian frontier.
- (2) Track: Double track with exception of Paris suburban area.
- (3) Maximum permissible axle-load: 20 tons.
- (4) Gradients: Maximum gradient against north-bound trains, 1 : 175; maximum gradient against south-bound trains, 1 : 200.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 10 km.
- (7) Marshalling yards (see Fig. 76): Paris (La Plaine), Creil, Tergnier, Aulnoye.
- (8) Engine sheds (see Fig. 76): Paris (La Chapelle), Paris (La Plaine), Joncherolles, Creil, Compiègne, Tergnier, St Quentin, Busigny, Aulnoye.

The first 30 miles of this line, as far as Creil, consist of a gentle rise and fall over the Tertiary limestone plateau of Valois. Except for a very short section at 1 : 84 two miles outside the Paris terminus, the ruling gradient is 1 : 200. Beyond Creil there is a gentle rise for 50 miles up the Oise valley, as far as the junction of Tergnier, where the Amiens-Laon line is crossed. The ruling gradient of this section is 1 : 333, but most of it is almost or actually level. Beyond Tergnier there is a gentle rise, interrupted only by slight descents to St Quentin and Le Cateau, over the chalk plateau of Cambrésis, here and there capped with loam and Tertiary rocks, to Aulnoye. The ruling gradient of this section is 1 : 200. From Aulnoye, where the line is crossed by the transverse route from Lille to Hirson, the Carboniferous and Devonian rocks of the edge of the Ardennes massif, which appear from beneath the cover of chalk, are traversed, as the line gradually descends the Sambre valley to the Belgian frontier.

(ii) *Paris-Calais* (Fig. 72)

*Summary*

- (1) Length: 299 km. (186 miles).
- (2) Track: Double track with exception of Paris suburban area.
- (3) Maximum permissible axle-load: 20 tons.
- (4) Gradients: Maximum gradient in both directions, 1 : 125.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 10 km.
- (7) Marshalling yards (see Fig. 76): Paris (La Plaine), Creil, Longueau, Abbeville, Boulogne (Outreau), Calais (Fontinettes).
- (8) Engine sheds (see Fig. 76): Paris (La Chapelle), Paris (La Plaine), Creil, Clermont, Longueau, Amiens, Abbeville, Étaples, Boulogne, Calais.

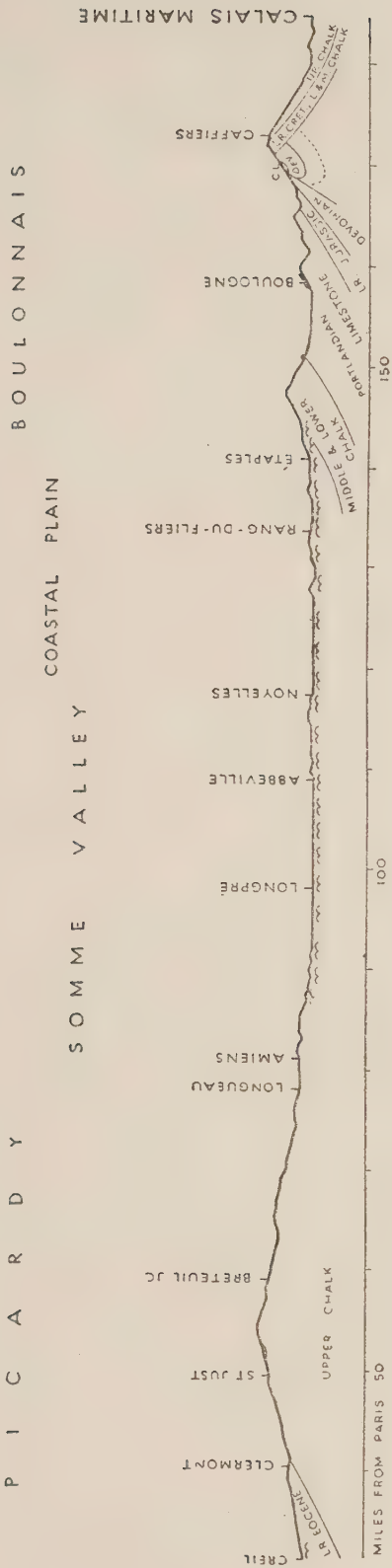


Fig. 72. Gradient profile, Creil-Calais

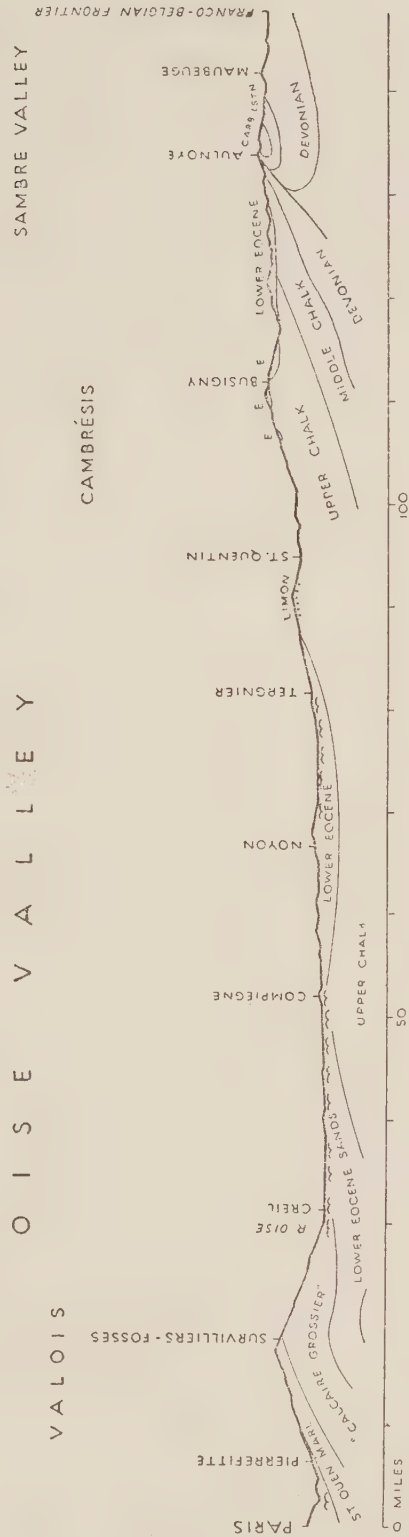


Fig. 73. Gradient profile, Paris-Maubeuge



Diverging from the Maubeuge line at Creil, this line crosses the chalk plateau of Picardy for 40 miles between Clermont and Amiens, rising and falling gently with no gradient steeper than 1:250. Beyond Amiens it follows the Somme valley to beyond Abbeville, and then curves northwards across the coastal plain to Étaples; for 44 miles the track is almost or quite level. Beyond Étaples the approach of the chalk plateau to the coast renders a coastal course impracticable, and the line rises fairly steeply (gradient 1:130–133) over the edge of the chalk plateau, dropping again to Boulogne. The final stretch between Boulogne and Calais across the 'weald' of the Boulonnais, in the core of which lies a small coalfield, is the most difficult section of the whole line; a rise of 6 miles at 1:125 to the summit at Caffiers is followed by an equally long and steep descent before the final flat stretch of 4 miles to Calais Maritime.

### (iii) *Paris-Lille* (Fig. 75)

#### *Summary*

- (1) Length (Longueau–Lille): 132 km. (82 miles).
- (2) Track: Double track throughout.
- (3) Maximum permissible axle-load: 20 tons.
- (4) Gradients: Maximum gradient in each direction, 1:200.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 12 km.
- (7) Marshalling yards (see Fig. 76): Longueau, Arras, Douai.
- (8) Engine sheds (see Fig. 76): Longueau, Arras, Douai, Lille (Fives).

Direct traffic from Paris to Lille and Belgium avoids entering Amiens, by-passing it via the great junction of Longueau. The 78 miles between Longueau and Lille commence with a gentle rise of 30 miles up the Ancre valley, with a ruling gradient of 1:200, which brings the line on to the loam-covered chalk plateau of Artois. A gentle and slightly interrupted descent follows for 27 miles through Arras to Douai, again with a ruling gradient of 1:200. For about 13 miles, from Corbehem through the junctions of Douai to Libercourt, the line crosses the concealed coalfield, and a number of pits lie adjacent to the railway. Another 10 miles of gentle undulations bring the line to Lille.

### (iv) *Amiens-Laon-(Chaumont, Eastern Region)* (Fig. 74)

#### *Summary*

- (1) Length: 108 km. (67 miles) (Amiens-Laon); 243 km. (151 miles) (Laon-Chaumont).
- (2) Track: Double track throughout.
- (3) Maximum permissible axle-load: Amiens-Laon, 20 tons, Laon-Chaumont, 18 tons.

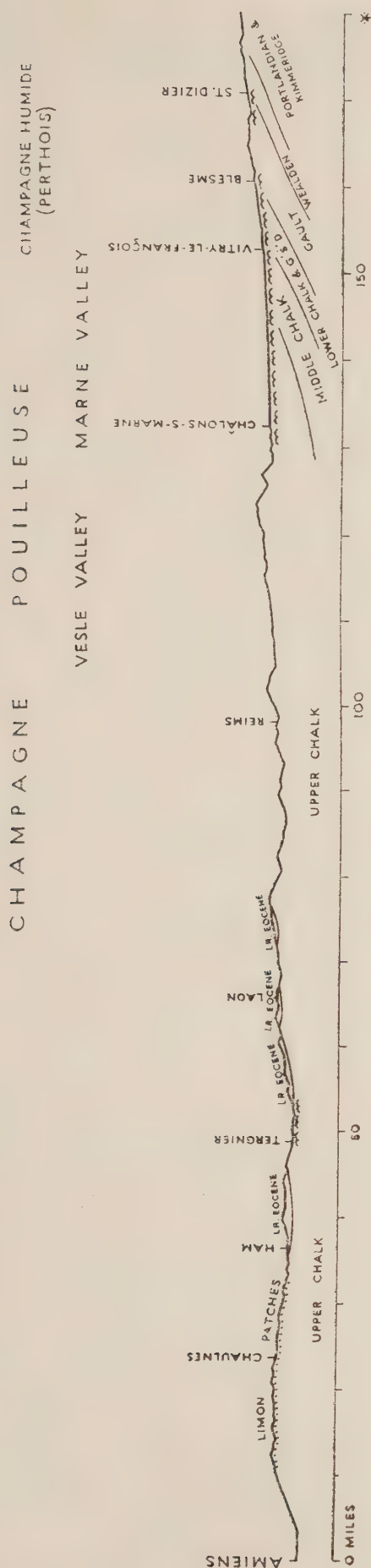


Fig. 74. Gradient profile, Amiens-Chaumont

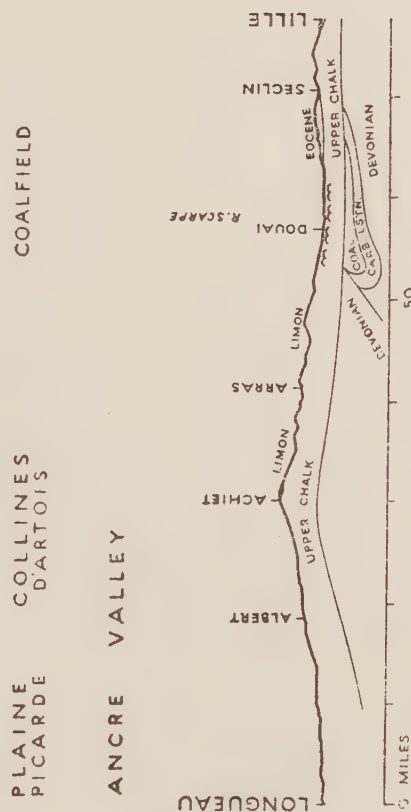
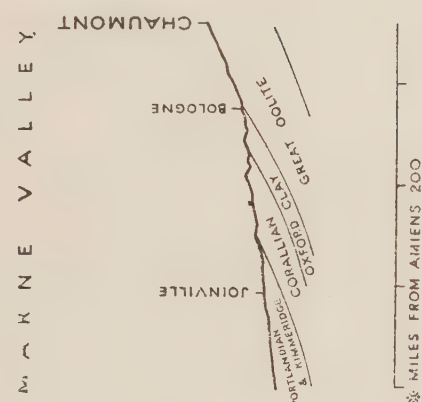


Fig. 75. Gradient profile, Longueau-Lille





(4) Gradients: Maximum gradient against east-bound trains, 1 : 167; maximum gradient against west-bound trains, 1 : 83 (for a short distance only, otherwise 1 : 125).

(5) Traction: Steam.

(6) Maximum distance between stations: 12 km.

(7) Marshalling yards (see Figs. 76, 82): Amiens, Longueau, Tergnier, Laon, Châlons-sur-Marne, St Dizier.

(8) Engine sheds (see Figs. 76, 82): Amiens, Longueau, Tergnier, Laon, Reims, Châlons-sur-Marne, Vitry-le-François, St Dizier, Joinville, Chaumont.

This important cross-route is followed by direct Channel-Switzerland trains; 66 of its 215 miles fall within the northern region, the remainder within the eastern region. The first 35 miles lie across the loam-covered chalk plateau to Ham; after a 10-mile ascent (including 7 miles at 1 : 200) to gain the plateau level the line is undulating, with a ruling gradient of 1 : 200. From Ham through Tergnier to Laon and Reims the undulations continue with the same ruling gradient, as the line skirts the ragged edge of the great Tertiary escarpment known as the 'falaise de l'Ile de France', crossing occasionally the outcrops of lower Tertiary sands which lie at the foot of the main limestone scarp. At Reims the first of the main eastern region lines is crossed, that from Paris to Mézières and Luxembourg. Through trains do not actually enter the city of Reims at all, by-passing it on the north-eastern side. Between Reims and Châlons-sur-Marne the heart of the Champagne Pouilleuse—the dry chalk plateau—is crossed, in part by following the Vesle valley for about 16 miles, on a gently rising gradient (including short 1 : 200 stretches but mostly 1 : 500 to 1 : 1000) which is ended by a sharp descent (which reaches 1 : 83 in one place, and has several stretches at 1 : 125 and 1 : 143) to the Marne valley at Châlons. From Châlons through Vitry-le-François to Blesme this cross-route follows the main Paris-Strasbourg line of the eastern region, with its very gentle ascent of the Marne valley between Châlons and Vitry (cf. Fig. 78). The 'Champagne Humide' region developed on Lower Cretaceous clays—here known as the 'Perthois'—is crossed between Vitry and St Dizier, and then, taking advantage once more of the Marne valley, the line gradually ascends to the Jurassic limestone plateau which bounds the Paris basin.

The Portlandian scarp is passed through at Donjeux and the Corallian scarp just before Bologne—but the gradient profile does not show this as the line follows the river through the gaps it has cut through the limestone escarpments. The ruling gradient for 40 miles from Blesme is 1 : 200, but thenceforward the valley becomes steeper, and the last 8 miles from Bologne to Chaumont are mostly at 1 : 167. At Chaumont the main Paris-Basle line of the eastern region is joined.

The route continues over the Paris-Basle line to Langres and then strikes southwards to Is-sur-Tille, where the south-eastern region (late P.L.M.) is entered; another 20 miles brings the line to the great junction of Dijon.

### *Axle-loads*

Most of the Nord main lines were laid with rails, ballast and bridge strengths to permit a 20-ton axle-load. Moreover, much of the secondary network permitted an 18-ton axle-load, and as a result the northern region as a whole was far ahead of the rest of France in this respect (see Fig. 70). Two factors have contributed to this state of affairs; in the first place the vast amount of reconstruction necessary after the 1914-18 war enabled heavier tracks to be laid and stronger bridges erected, and secondly, the considerable coal traffic passing over the main line, especially from the coalfield to Paris and towards Lorraine, made the provision of heavy locomotives and large freight vehicles a vital necessity, the technical problems of the construction of such rolling stock being rendered much easier by the high axle-load allowed.

### *Passenger Traffic*

Passenger traffic on the Nord railway in 1936, the latest date for which figures are available, totalled nearly 118 millions. Of these 94.1% travelled 3rd class, 5.4% 2nd class and 0.4% 1st class—but the percentage of the receipts derived from 3rd class fares was only 69, a result of the great importance of long-distance international traffic which was mainly 1st and 2nd class. The passenger traffic falls into five classes:

(i) *Paris Suburban*. The suburban and outer-suburban services extend as far as Pontoise (30 km.), Persan-Beaumont (37 km.), Creil (51 km.) and Crépy-en-Valois (61 km.); in addition the 52 km. section of the Grande Ceinture from Argenteuil through Noisy-le-Sec to Juvisy is worked as part of the northern region, though the passenger traffic on this line, mainly worked by railcars, is not heavy.

(ii) *International Traffic*. There are four major traffic streams: (a) From the Channel ports—Boulogne, Calais and Dunkirk—to Paris; from the last-named of these ports the train-ferry service from Dover, inaugurated in 1936, enabled through communication, without change of vehicle, to be established between London and Paris. (b) From the Channel ports (principally Dunkirk and Calais) to Belgium (for Holland and Germany); the lines from Calais and Dunkirk join at



Hazebrouck and traffic proceeds thence to Lille, diverging for Ghent, Antwerp and Amsterdam and for Brussels, Liège and Germany.

(c) From the Channel ports to the eastern region; the chief routes are via Amiens and Laon and via Lille and Hirson. (d) From Paris to Belgium (for Holland and Germany); the main routes are via Lille to Antwerp, and via Aulnoye to Brussels and to Liège.

(iii) *Channel Seaside Resorts*. A considerable seasonal traffic exists between Paris and Le Tréport (served by the main line via Beauvais), and the many 'plages' which lie between Le Tréport and Calais, most of which are served by light railways or tramways from stations on the main Paris-Boulogne-Calais line.

(iv) Local traffic in the industrial area is not perhaps as great as might be expected, since so many of the workers live in the 'cités ouvrières' adjacent to the mines and works; moreover, some of the colliery companies run passenger services on their private lines. There is some daily movement of workers to and fro across the Belgian frontier, for the distribution of population and of industry are little affected by that frontier.

(v) Lastly, there is the general and diverse passenger traffic of the rest of the system.

### *Freight Traffic*

Of a total traffic amounting to over 51 million tons in 1936, almost 20 million tons consisted of coal and coke, and nearly 4 million tons of iron and steel—an obvious indication of the importance of the coalfield industrial area in the economy of the Nord railway. The coalfield, 120 km. in length and 15–20 km. broad, extends from Ligny to the Belgian frontier, and there are close on 200 individual pits, providing nearly two-thirds of all France's coal. The collieries have a considerable mileage of their own railways—e.g. the Bruay concession alone has 156 km.—which contact the Nord railway at thirty-five separate points which are thus the starting points of the coal traffic. Only about one-third of the output of coal is used locally in the coke ovens, iron and steel works, power stations and factories, the remaining two-thirds being sent out of the area. Of the quantity sent out, about three-quarters travels by rail and one-quarter by waterway. The tonnage of coal received by the railway from the collieries has reached 50,000–100,000 tons per day in recent years.

Some preliminary sorting of the laden wagons according to destination is done at the larger contact stations, e.g. Louches, Billy-Montigny, but five main marshalling yards collect the traffic and pass



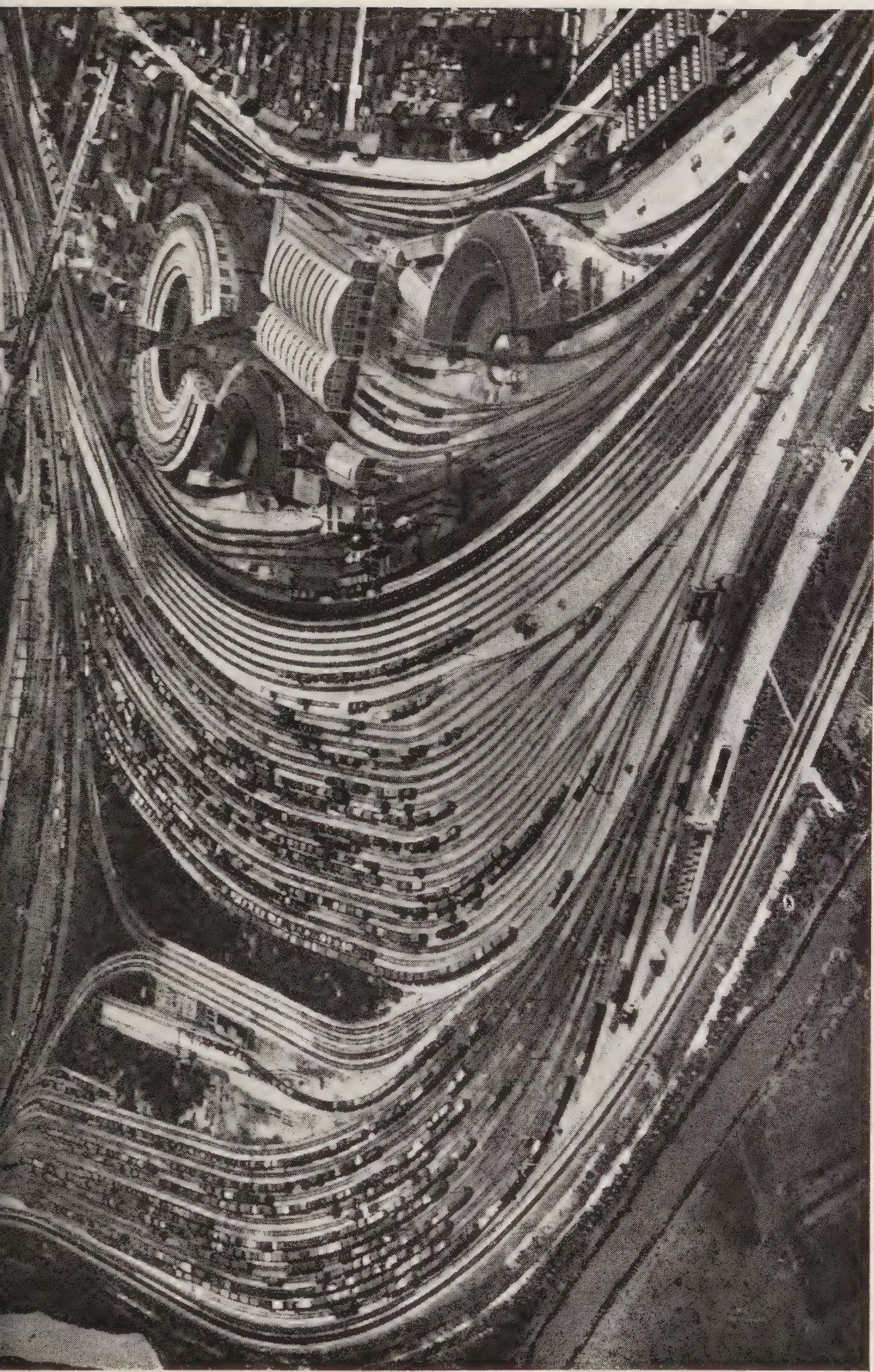


Plate 58. The marshalling yards at Longueau, near Amiens

The shunting humps and control box are in the foreground; the left-hand group of sidings deals with traffic for the Amiens-Calais line, the right-hand group with traffic for the industrial north. On the right are four semi-circular locomotive sheds (the standard continental pattern, very seldom seen in Britain), and a repair shop.





Plates 59, 60. Specialized rail transport

Plate 59 (above) shows a 2000-ton coal train, made up of special 60-ton all-steel hoppers and drawn by a 2-10-0 locomotive specially built for the purpose, leaving Lens for Paris. Plate 60 (below) shows a tank wagon for wine traffic, photographed in a P.L.M. siding at Aigues-Mortes.



it on, much of it in complete trainloads, to the Paris area and elsewhere. The greatest of these is Lille-La Délivrance, a huge modern hump-yard with a capacity of some 7,000 wagons per day. Smaller ones exist at Valenciennes (capacity 1,000–1,500 wagons per day), the main centre for traffic passing to the eastern region, Douai (capacity 1,000–1,400 per day), in the heart of the industrial region, Somain and Lens (see Vol. III, Fig. 66).

There are four groups of destinations for the coal traffic. The chief is the Paris area, where the huge modern marshalling yard at Le Bourget (capacity 7,000–8,000 wagons per day) receives the coal trains and passes on wagons to the other great traffic centres in the Parisian outer girdle—Achères, Juvisy and Villeneuve. Secondly, coal traffic goes via Aulnoye and Hirson to the eastern region where its principal destination is the Lorraine ironfield. Thirdly, there is a miscellaneous group of places, such as the Channel ports (where, however, English or Welsh coal tends to undersell the French product), Longueau marshalling yard (whence the coal goes via Rouen to the western region), and Tergnier yard (for Reims and the eastern region). Fourthly, coal (mainly household type) moves across the frontier into Belgium—and incidentally Belgian coking coal moves into France along the same lines; no less than nine lines (five of them double track) lead across the frontier between Tourcoing on the west and Maubeuge on the east.

The Paris traffic is routed either by Louches-Busigny-St Quentin, or by Arras and Longueau, though in times of particularly heavy traffic the Douai-Cambrai-Chaulnes route has also been used. A special fleet of 'decapod' engines (class 5.1200) was built to work this traffic, some of which passes in complete train loads to the Paris gasworks and power stations (Plate 59). This traffic is probably on the decline owing to the increased use by Paris of hydro-electric power transmitted from the Central Massif. The traffic to Lorraine is not so likely to diminish, but the operation of this section is more difficult owing to the accidented character of the Hirson route, which reduces by as much as 300–400 tons the capacity of individual trains.

The Nord railway also carried more foodstuffs than any other railway; in 1936 this traffic amounted to over 5 million tons, of which nearly half consisted of cereals and flour. The reasons for this heavy traffic are not far to seek. In the first place the line serves the richest agricultural region of France, and considerable quantities of cereals and of sugar-beet thus travel by rail; secondly, it serves the two greatest agglomerations of population in France, Paris and the northern



industrial region, and, moreover, links both these urban areas with the principal northern freight port of Dunkirk, through which pass considerable quantities of imported foodstuffs (cf. p. 229); thirdly, though this hardly accounts for a very great tonnage, it serves France's chief fishing port, Boulogne, which is the point of origin of a valuable and regular service of refrigerated vans carrying fish to the Paris region and beyond. Other commodities in the carriage of which the Nord railway held first place are timber, 'stones' and lime (including cement). The timber is largely pit-props for the coalfield, the 'stones' include building stones from the Tertiary limestones of the Oise valley, road metal from the old rocks of the Maubeuge area, and limestone for blast furnaces, and the lime and cement—to the extent of about one-third of the entire French output—are derived from the huge works which abound in the Chalk and Portland limestone regions extending from the Channel coast to the upper Oise valley.

### *Sheds, Works, Marshalling Yards*

The principal locomotive sheds are shown on Fig. 76 (on which only the more important lines are indicated). The largest (each normally accommodating more than 100 engines) are at Valenciennes, Longueau, Hirson, Paris (La Chapelle), Lens and Dunkirk (Coudekerque). Of these, Valenciennes and Lens serve the coalfield, Coudekerque serves the considerable traffic of the port of Dunkirk, Hirson deals with the traffic to and from the eastern region, and La Chapelle is the main passenger-engine shed for Paris.

The main locomotive works are at La Chapelle and Hellemmes (on the eastern side of Lille, adjacent to Fives); large repair shops exist at Coudekerque, Amiens, Lens, Laon, Hirson and Tergnier, with carriage and wagon repair depots at Paris (Le Landy), Tergnier and Ermont.

The main marshalling yards and concentration sidings are also shown on Fig. 76. The biggest hump-yards are at Lille-Délivrance, Longueau (the great junction almost in the geometrical centre of the system) (Plate 58) and Le Bourget.

### EASTERN REGION

This division of the S.N.C.F. comprises the former Est railway and the state-operated A.L. lines, together totalling some 7,078 km. (4,398 miles) of line, of which 5,435 km. (3,377 miles) are double track. Both the Est and the A.L. had a considerable freight traffic, due very

largely to the division of the Lorraine ironfield between the two systems and to the considerable coal and coke traffic from the Ruhr and from northern France which the Lorraine smelting industry engendered. The eastern region is thus easily the most important

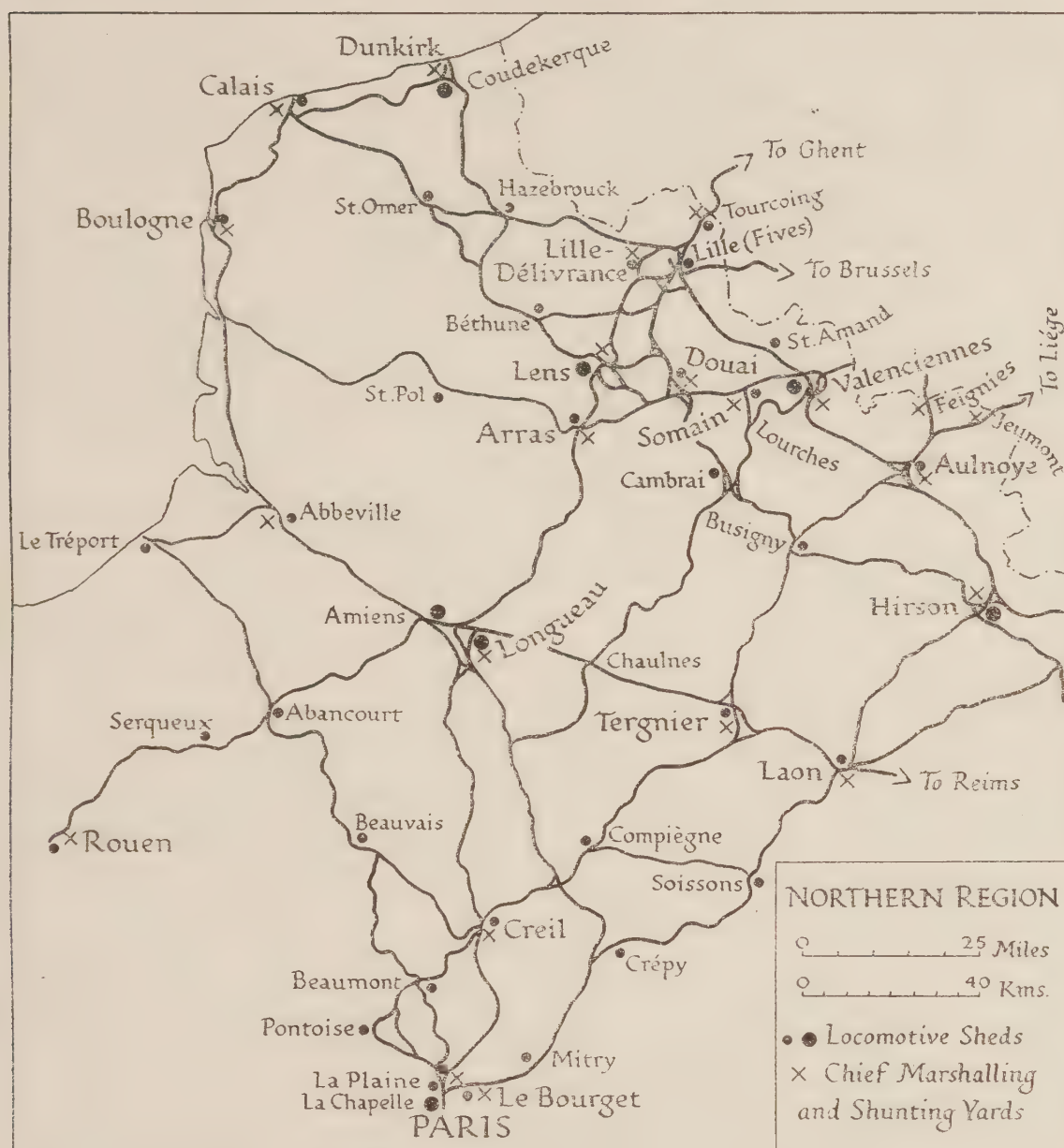


Fig. 76. The main lines of the *Région Nord*

Showing the location of the chief locomotive sheds and marshalling yards.  
The more important sheds are indicated by the larger symbols.

freight-carrying part of the French national railways; it is second only to the western region in the matter of passengers.

The main lines of the eastern region are not so simply arranged as those of the northern region. The two main radial lines diverge at Noisy-le-Sec, just outside Paris; one runs via Châlons-sur-Marne,



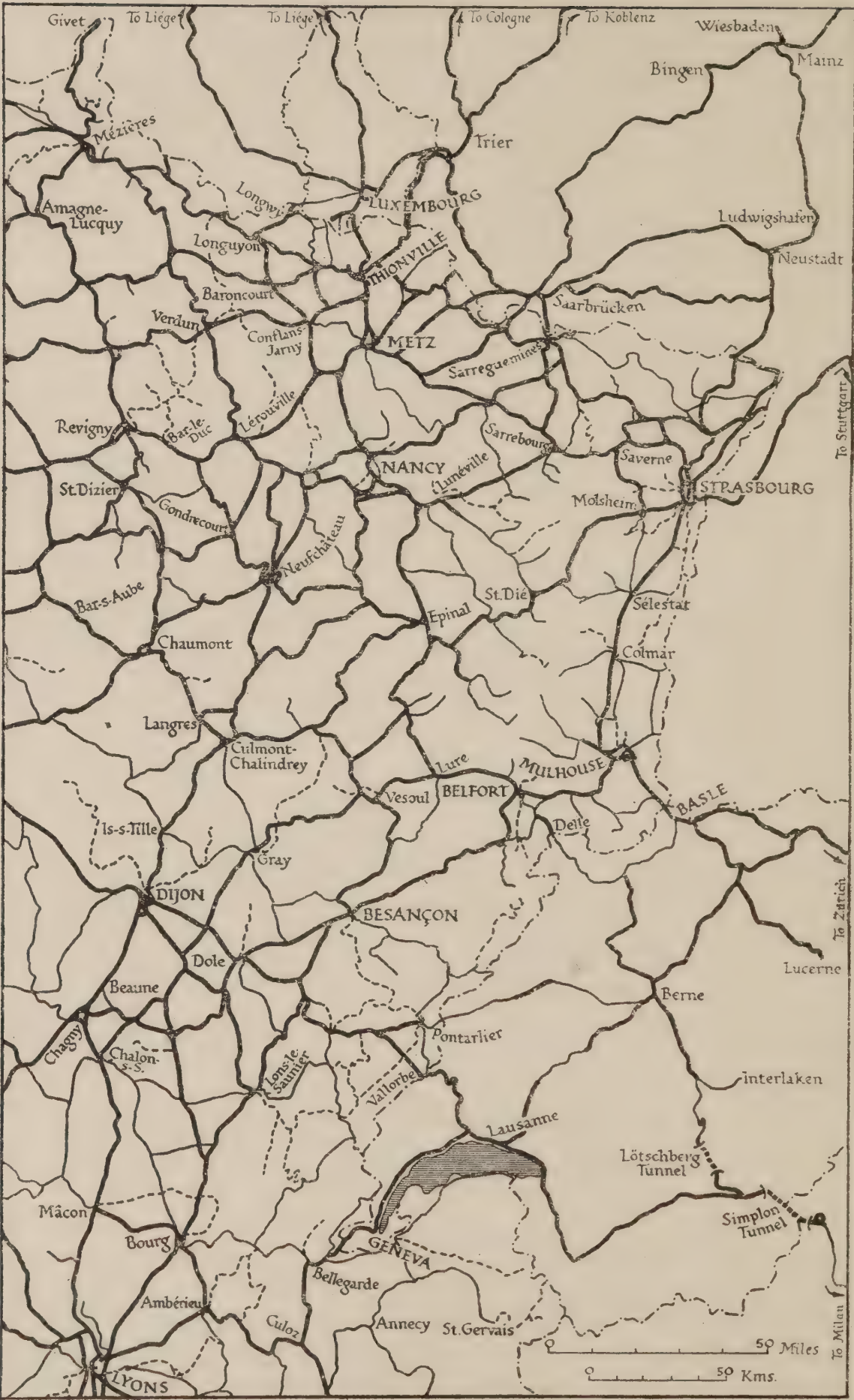


Fig. 77. Railways in eastern France. For key see Fig. 71.

Nancy and Saverne to Strasbourg, and the other via Troyes, Chaumont and Belfort to Basle (Switzerland). Three important lines diverge from the first of these: one from near Meaux to Reims, Mézières-Charleville, Longuyon and Luxembourg; one from Châlons to Verdun and Metz and a third from Lérrouville to Metz and thence across the German frontier to Saarbrücken. The Mézières-Longuyon section of the Paris-Luxembourg line forms in addition a part of the important link between the northern coalfield and the Lorraine iron-field, the remaining portions of which are Hirson-Mézières and Longuyon-Thionville; this route is also used by passenger expresses from Dunkirk and Calais to Basle. There are three main north-south routes which cross and link the major east-west trunk lines. The Laon-Châlons-Chaumont-Is-sur-Tille line linking the northern and south-eastern regions has already been described. A second is the Luxembourg-Thionville-Metz-Nancy-Neufchâteau-Is-sur-Tille line; a third is a branch of this, linking Nancy with Épinal and Lure (for Belfort), whilst the main line of the former A.L. system runs from Basle through Mulhouse and Colmar to Strasbourg, thence forking to Sarreguemines (for Saarbrücken) and Wissembourg (for German Rhineland).

Although scarcely part of the main-line network, the two trans-Vosges lines, constructed since the 1914-18 war to provide better connexion between Alsace and the rest of France, deserve mention. The St Dié-Saales line, completed in 1928, carries through Strasbourg-Dijon expresses; the St Dié-St Marie-aux-Mines link, opened in 1937, is less important economically. Both constructions involved long tunnels through the watershed of the Vosges, which formed the Franco-German frontier from 1871 until 1918.

Incorporated for operational purposes in the A.L. system, and so now in the S.N.C.F. is the Guillaume-Luxembourg line, which consists of two main lines, one from north-south and the other east-west, crossing at Luxembourg. The north-south line provides a through route from Liège to Lorraine, and the western and southern arms of the cross carry through traffic from Ostend and Brussels to Strasbourg and Germany.

#### (i) *Paris-Strasbourg* (Fig. 78)

##### *Summary*

- (1) Length: 503 km. (313 miles)
- (2) Track: Paris-Lagny, 4 tracks (28 km.); Lagny-Vitry-le-François, double track (177 km.); Vitry-le-François-Lérrouville, 4 tracks (84 km.); Lérrouville-Blainville, double track (87 km.); Blainville-Sarrebourg, 4 tracks (57 km.); Sarrebourg-Strasbourg, double track (70 km.).



- (3) Maximum permissible axle-load: 18 tons.
- (4) Gradient: Maximum gradient in both directions, 1 : 125.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 13 km.
- (7) Marshalling yards (see Fig. 82): Pantin, Noisy-le-Sec, Vaires, Châlons-sur-Marne, Nancy (Champigneulle and Jarville), Blainville, Strasbourg-Hausbergen.
- (8) Engine sheds (see Fig. 82): Paris (La Villette), Noisy-le-Sec, Vaires, Meaux, Château-Thierry, Epernay, Châlons-sur-Marne, Vitry-le-François, Revigny, Bar-le-Duc, Lérrouville, Commercy, Sorcy, Toul, Nancy, Blainville, Lunéville, Igney-Avricourt, Sarrebourg, Saverne, Strasbourg.

The first 158 miles of this route, as far as Bar-le-Duc, are the most perfectly graded line in all France. Apart from one or two quite insignificant stretches at 1 : 200 near Meaux, where the line cuts across meanders of the river Marne, there is scarcely a gradient worth mentioning, and much of the track is level or at such gentle slopes as 1 : 2,500. This is all the more surprising when it is remembered that a line running eastwards from Paris crosses the Tertiary and Cretaceous scarplands of Brie and Champagne. The reason, of course, is the existence of the Marne valley, which cuts gaps through the scarps and gives a passage to the railway for some 120 miles. The line strikes the Marne when only 11 miles from Paris, and hugs it closely as far as Vitry-le-François. The Tertiary scarp, the 'falaise de l'Île de France', is passed through at Epernay, and then for 40 miles, through Châlons-sur-Marne, the Marne valley is cutting into the dry chalk plateau—'Champagne Pouilleuse'—the scarp being cut through just before Vitry. Between Vitry and Bar-le-Duc, across 'Champagne Humide', the gradient steepens slightly as the line reaches and follows the Ornain valley; there is one short stretch at 1 : 285. Beyond Nançois the line strikes across the Portland limestone escarpment which forms the watershed between the Ornain and the Meuse. A 6-mile ascent at 1 : 125 is soon followed by a precisely similar descent to Lérrouville, the junction of the recently constructed (1931) through line to Metz. This is the only difficult section of the whole 313-mile route. Beyond Lérrouville the line ascends the Meuse valley for 10 miles, and passes through the Corallian limestone escarpment known as the 'côtes de Meuse' in the remarkable Toul gap, cut by the Moselle when in a former geological age it joined the Meuse; the gradient averages about 1 : 285 through the gap. Beyond Toul the Moselle valley is followed through the 'oolitic' scarp; the line is gently undulating, with a ruling gradient of 1 : 200, for 16 miles to Frouard, where it turns sharply southwards up the Meurthe valley to Nancy.

Between Nancy and Strasbourg the line takes advantage of the

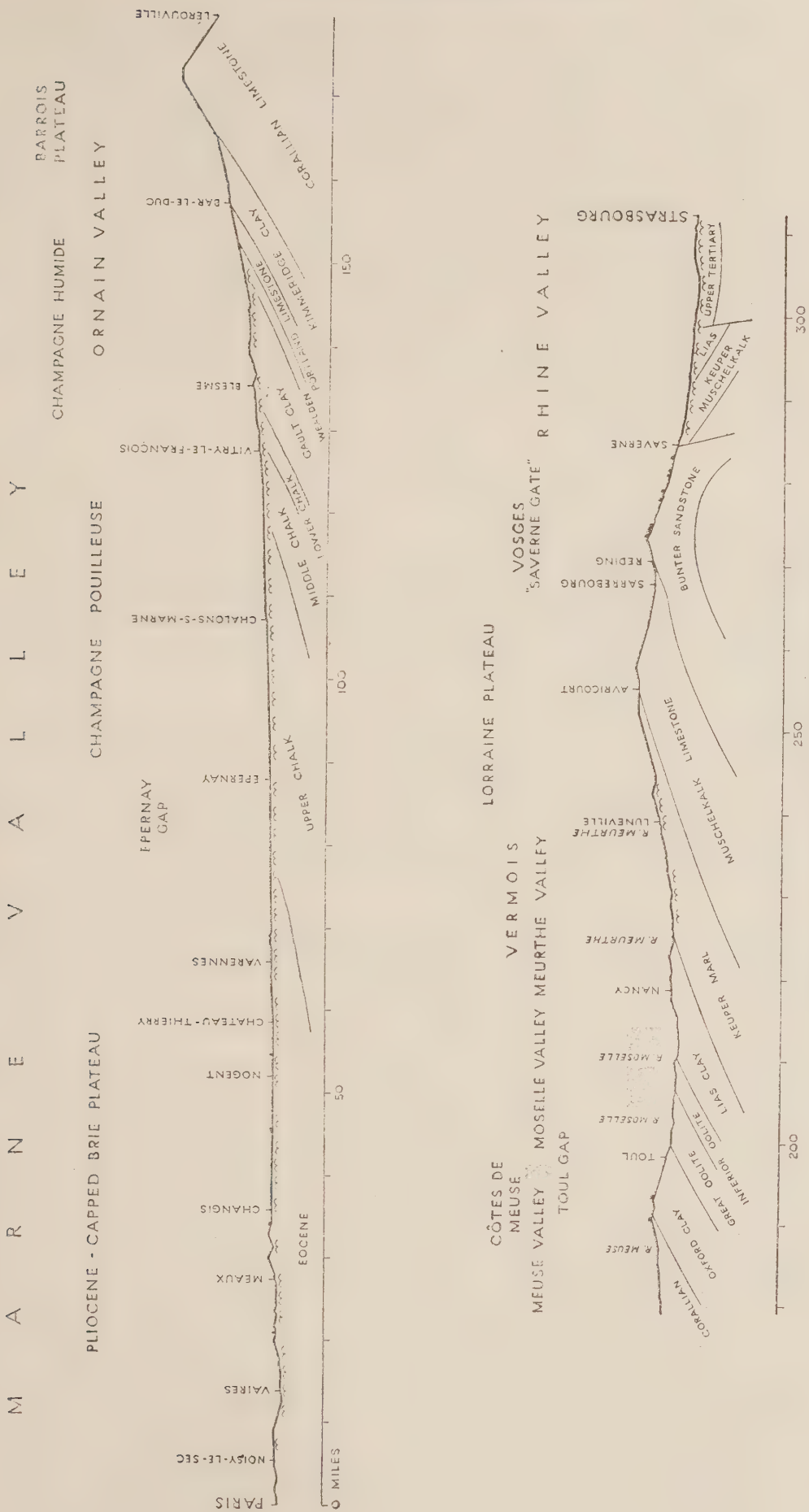


Fig. 78. Gradient profile, Paris-Strasbourg



Saverne gap through the northern part of the Vosges. The Meurthe valley is followed through the Vermois region to Lunéville, on a gentle gradient with nothing steeper than 1 : 270; beyond Lunéville the line rises gently over the Lorraine plateau to Avricourt, which was formerly the point of union of the Est and A.L. railways, descending thence through the forested sandstone country which forms the Low Vosges to Saverne. The steepest gradient on the descent is 1 : 141, but most of the line is much more gently inclined than this; there are several long tunnels. At Saverne the edge of the Rhine Rift valley is crossed, and the line descends gently, with only a few short sections at 1 : 200, to Strasbourg.

## (ii) *Paris-Basle* (Fig. 79)

### *Summary*

- (1) Length: 526 km. (327 miles)
- (2) Track: Double track with exception of Paris suburban area.
- (3) Maximum permissible axle-load: Paris-Chaumont, 18 tons; Chaumont-Belfort, 16 tons; Belfort-Mulhouse, 18 tons; Mulhouse-Basle, 16 tons.
- (4) Gradients: Maximum gradient against east-bound trains, 1 : 110; maximum gradient against west-bound trains, 1 : 140.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 11 km.
- (7) Marshalling yards (see Fig. 82): Pantin, Noisy-le-Sec, Troyes, Chaumont, Langres, Vaivre, Belfort, Mulhouse, Basle (St Louis).
- (8) Engine sheds (see Fig. 82): Paris (La Villette), Noisy-le-Sec, Verneuil, Romilly-sur-Seine, Troyes, Chaumont, Langres, Culmont-Chalindrey, Vitrey-Vernois, Port-d'Atelier, Vaivre, Vesoul, Lure, Belfort, Mulhouse, Basle.

The gradient profile of this line, which makes less use of major river valleys, shows a much closer adaptation to geological circumstances than the Paris-Strasbourg line, and in consequence the slopes are steeper. The steepest gradient is actually 1 : 110, and there are many stretches at between 1 : 140 and 1 : 170. After crossing the river Marne about 10 miles from Paris, the line climbs sharply (1 : 110) to the level of the Brie limestone plateau, across the undulating surface of which it runs for about 40 miles. A fairly steep descent of the Tertiary scarp follows, mostly at 1 : 160, to the Seine valley, and for the next 50 miles, to just beyond Troyes, the line gradually ascends this valley, with no gradient steeper than 1 : 250 and long stretches flatter than 1 : 500, thus crossing the Champagne Pouilleuse and passing through the chalk scarp with ease. Beyond Troyes, the Champagne Humide lowland is crossed obliquely on a gradually rising gradient until a sharp drop at 1 : 150 carries the line down to the floor of the Aube valley. By following this valley for 10 miles or so through Bar-sur-Aube, the passage through the Portland limestone

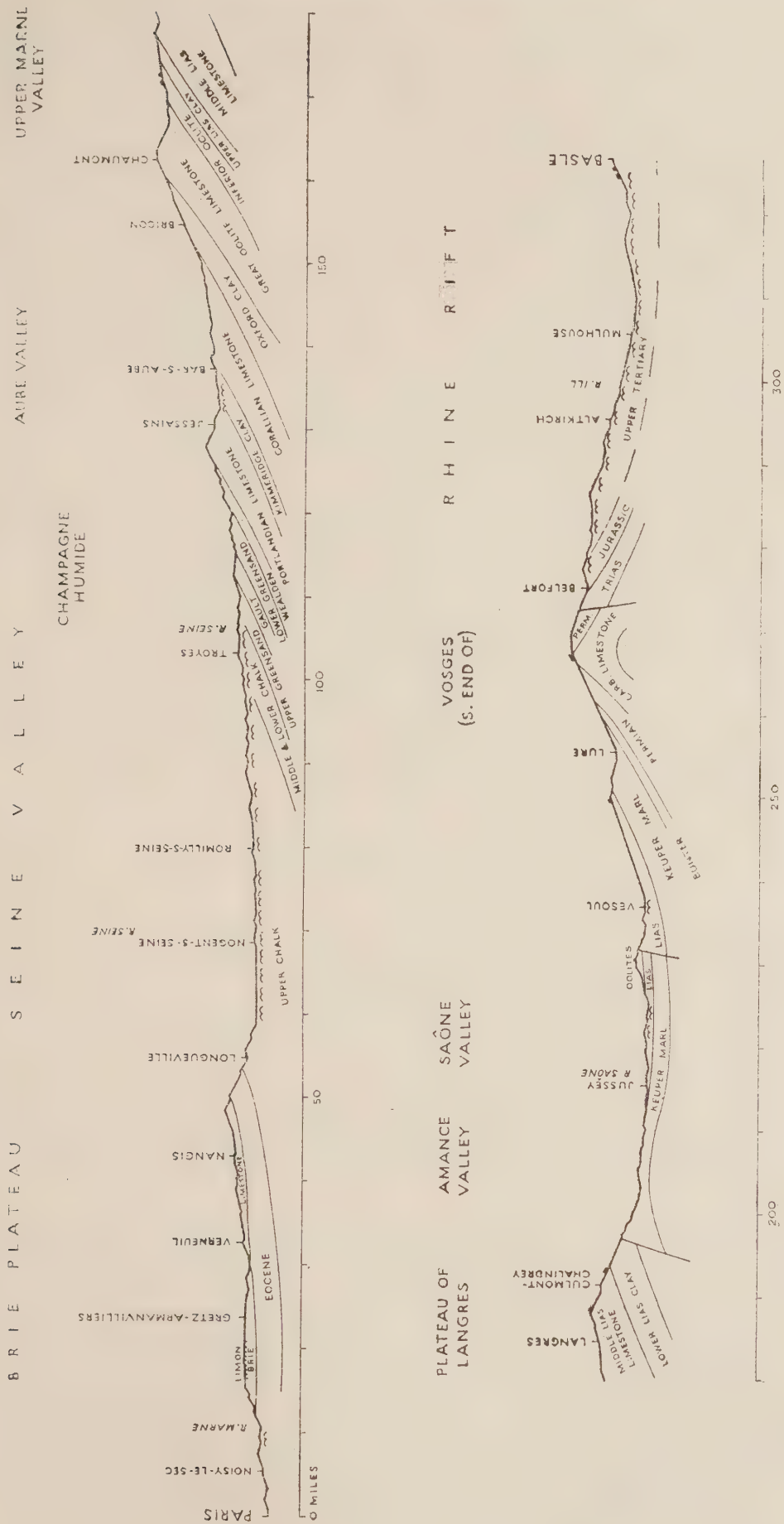


Fig. 79. Gradient profile, Paris-Basle



scarp is effected. Then the ascent of the Jurassic dipslope begins in earnest. The narrow Oxford clay vale is used to secure a relatively easy crossing ( $1:140$ – $1:150$ ) of the Aube-Marne interfluvium, and the upper Marne valley is followed for 20 miles from Chaumont to Langres, with no gradient steeper than  $1:200$ . The summit of the Langres plateau, marking the edge of the Paris basin and the English Channel-Mediterranean watershed, is reached halfway between Langres and Culmont-Chalindrey, where the Nancy-Dijon line is crossed. From the summit, a fairly steep descent for 13 miles, mostly at  $1:167$ , carries the line across the imposing Liassic limestone scarp and down to the Amance valley, and so to the upper Saône. Gradients are gentle down these valleys, but a slight hump with  $1:170$  on both sides occurs before Vesoul. Between Vesoul and Belfort the low southern end of the Vosges is crossed; a 30-mile climb, interrupted only by a slight drop to Lure, leads to the summit; the last 10 miles of the ascent are mostly at  $1:167$  with a section at  $1:150$ . The descent to the Belfort 'gap' (between the Vosges and the Jura) is rather less steep, and there follows a more easily graded crossing of the southern end of the Rhine Rift valley, with considerable stretches at  $1:200$ , through Mulhouse, ending in a sharp rise through tunnels, at  $1:143$ , across the frontier to Basle.

### (iii) *Paris-Charleville* (Fig. 80)

#### *Summary*

- (1) Length, 244 km. (152 miles).
- (2) Track: Double track with exception of Paris suburban area.
- (3) Maximum permissible axle-load: 18 tons.
- (4) Gradients: Maximum gradient against east-bound trains,  $1:100$ ; maximum gradient against west-bound trains,  $1:167$ .
- (5) Traction: Steam.
- (6) Maximum distance between stations: 11 km.
- (7) Marshalling yards (see Fig. 82): Pantin, Noisy-le-Sec, Vaires.
- (8) Engine sheds (see Fig. 82): La Villette, Noisy-le-Sec, Vaires, Meaux, Reims, Amagne-Lucquoy, Mohon.

This line diverges from the Strasbourg main line at Meaux, 27 miles from Paris. Thence, after cutting across the sweeping meanders of the Marne for 9 miles, it follows the valley of the Ourcq for 30 miles almost to its head, finding a way thus across the eastern part of the limestone plateau of Valois. Its course is undulating, for the valley is narrow and there are frequent rises across the cores of the meanders; the steepest gradients are at  $1:167$ , notably in the last few miles, before the summit near La Fère-en-Tardenois. A descent of about 8 miles, mostly at  $1:167$ , carries the line down to the Vesle valley at

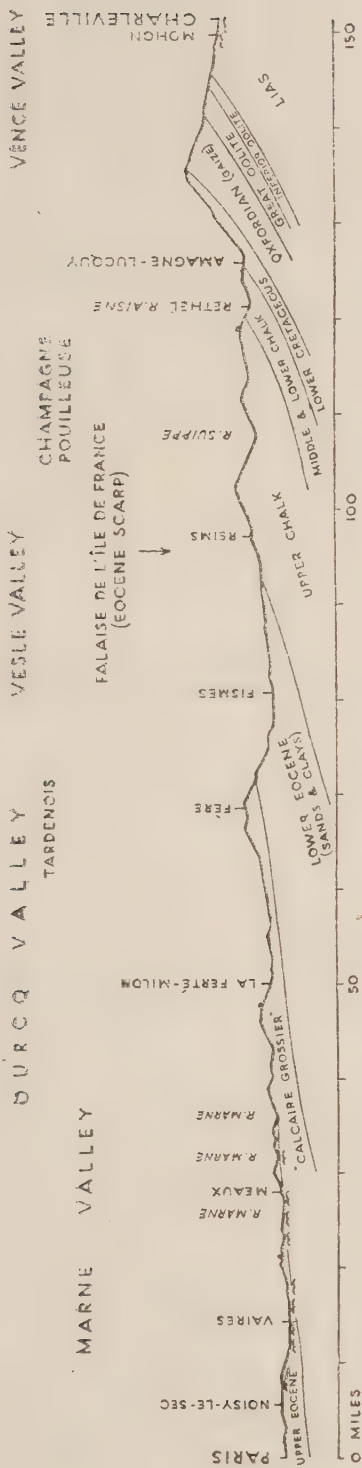


Fig. 80. Gradient profile, Paris-Charleville

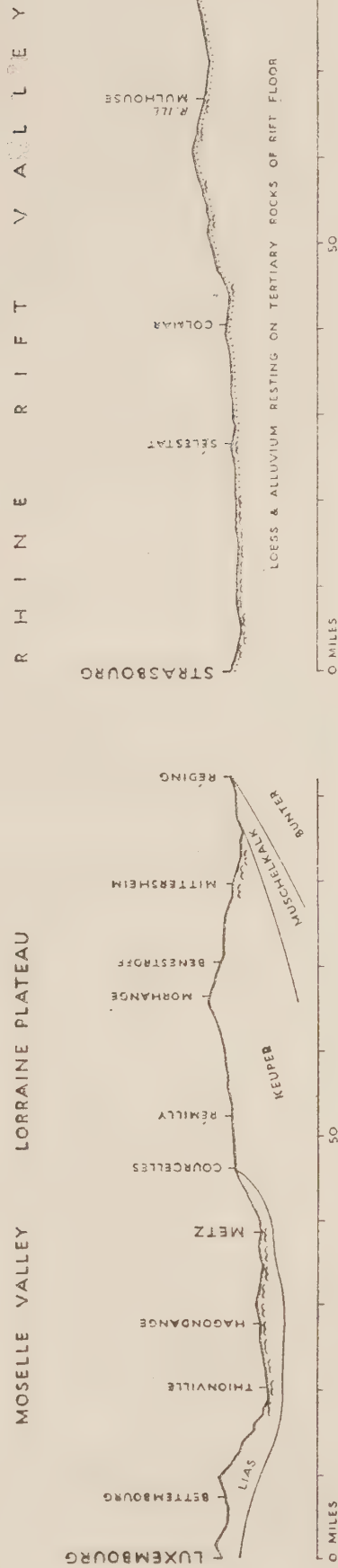


Fig. 81. Gradient profile, Luxembourg-Basle  
(For Reding-Strasbourg section see Fig. 78.)



Fismes, and this valley, one of several which have cut through and thus given a ragged edge to the Tertiary escarpment (falaise de l'Île de France), is ascended gently (mostly 1 : 500 or less) to Reims. Between Reims and Rethel the dry chalk plateau (Champagne Pouilleuse) is crossed for 23 miles in a series of broad undulations, the ruling gradient of which is again 1 : 167. After crossing the Aisne valley at Rethel the line begins to climb to the Jurassic scarpland which separates the Aisne valley, cut in soft Lower Cretaceous rocks, from that of the Meuse, cut between Sedan and Mézières in equally soft Liassic clays. A 9-mile climb, much of which is at 1 : 100, leads from Amagne-Lucquy to the summit, which is on the escarpment formed by the sandy clay (or 'gaize') of the Oxfordian, and a more gentle 15-mile descent (1 : 200 flattening to 1 : 333) following the small valley of the Vence, brings the line to Mézières-Charleville, one of the great railway junctions of the north.

(iv) *Luxembourg-Strasbourg-Basle* (Fig. 81)

*Summary*

- (1) Length: 364 km. (226 miles).
- (2) Track: Luxembourg-Thionville (33 km.) double track; Thionville-Metz (30 km.) 4 tracks; Metz-Basle (301 km.) double track.
- (3) Maximum possible axle-load: 18 tons.
- (4) Gradients: Maximum gradient against south-bound trains, 1 : 143; maximum gradient against north-bound trains, 1 : 77.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 9 km.
- (7) Marshalling yards (see Fig. 82): Bettembourg, Thionville, Metz, Strasbourg (Hausbergen), Colmar, Mulhouse, Basle.
- (8) Engine sheds (see Fig. 82): Luxembourg, Bettembourg, Thionville, Metz, Benestroff, Sarrebourg, Saverne, Strasbourg, Sélestat, Colmar, Mulhouse, Basle.

This main line of the former A.L. system first runs for 8 miles over the Guillaume-Luxembourg railway, as far as the French frontier. Once inside France, a steep descent is made, with severe gradients of 1 : 77 and 1 : 83, to the Moselle valley, which is reached just before the big junction of Thionville. For 20 miles from Thionville to Metz the main line, gently undulating, follows the Moselle valley at the foot of the eastward-facing scarp of the iron-bearing plateau. Numerous iron and steel works lie alongside the line, and Hagondange is the junction of the branch which serves the Orne valley mines and smelters.

Metz is another great converging point of routes—from Paris (via Verdun and via Lérrouville), from the south via Nancy, from Saarbrücken and from Strasbourg. From Metz the line turns eastwards,

striking across the Lorraine plateau for 50 miles. There is a short stretch of 1 : 167 on the climb to the plateau level, but thenceforward there are no gradients steeper than 1 : 200. At Remilly the line to Saarbrücken and the Rhine valley diverges north-eastwards, and at Benestroff the Sarreguemines-Nancy line is crossed. At Reding, a junction lying just to the east of Sarrebourg, the main Paris-Strasbourg line is encountered, and this is followed through the Saverne 'Gate' to that city. The 90-mile stretch from Strasbourg to Basle, on the floor of the Rhine Rift valley, is for the most part a gentle rise, only slightly interrupted, as through Mulhouse, by descents. The first 40 miles, apart from two short sections at 1 : 143, is mainly gentler than 1 : 500, but the latter half of the journey is in general slightly more steeply inclined with several stretches of 1 : 250. Between Mulhouse and Basle the line is the track of the Paris-Basle line already described.

### *Axle-loads (Fig. 70)*

In 1938 there was no section of the eastern region equipped for an axle-load greater than 18 tons, and only a comparatively small proportion of the mileage possessed an infrastructure capable of taking even this load. The main lines from Paris to Mézières and to Strasbourg, and from Thionville to Basle, could take 18-ton axle-loads, but the Paris-Belfort line was only so equipped as far as Chaumont. There was, however, a notable concentration of 18-ton track in the Lorraine ironfield, for reasons similar to those adduced for the northern region (cf. p. 259), and the important mineral-carrying line from Lorraine through Mézières to Hirson was similarly equipped, as was the Laon-Reims-Chaumont cross-country express route. The remainder of the lines, other than those shown on Fig. 70, were equipped for 16-ton axle-loads, with the exception of one or two short and unimportant lines (e.g. Romilly-Sézanne) on which 15 tons was the maximum permissible.

### *Passenger Traffic*

Passenger traffic on the lines of the eastern region in 1936 totalled 137 millions, of which 81 millions were on the Est railway and 56 millions on the A.L. lines. On the Est 92·4 % of the passengers travelled third class, on the A.L. 95·2 %, the highest percentage of all the major systems. Much of the A.L. passenger traffic takes place in the Lorraine industrial area, which would account for the high proportion of third-class travel, and which also accounts for the fact



that 84% of the receipts from passenger traffic were produced by third class fares, easily the highest percentage of any system.

The passenger traffic of the region comprises four main types, Paris suburban, Lorraine industrial area, international (Luxembourg, Germany and Switzerland), and finally the general traffic over all parts of the system. Paris outer-suburban services extend as far as Château-Thierry (95 km.), Coulommiers (34 km.), and Verneuil l'Étang (53 km.), the last-named locality having alternative routes via the main Belfort line and via the local line from the Bastille terminus (cf. Fig. 101). The local passenger traffic, mainly of workmen, in the Lorraine iron and steel area takes place mainly on the lines within an area bounded by Thionville-Mont St Martin-Longuyon-Conflans-Jarny-Metz. International traffic takes place mainly over the following lines: Paris-Reims-Mont St Martin (for Luxembourg, Trier, Cologne and Berlin), Paris-Bar-le-Duc-Metz-Apach (for Saarbrücken, Frankfurt, Berlin and Stuttgart), Paris-Nancy-Strasbourg (for Stuttgart, Munich, Prague and the Balkans ('Orient Express')), Paris-Troyes-Belfort-Basle (for Berne, Milan, Salzburg ('Tyrol Express'), Vienna and the Balkans ('Arlberg-Orient Express')), Laon-Chaumont (followed by Calais and Boulogne portions of expresses bound for the Riviera, Italy, Switzerland (e.g. 'Oberland-Engadine Express'), Austria and the Balkans), and Thionville-Sarrebourg (followed by traffic from Holland and Belgium via Luxembourg to Strasbourg and Switzerland).

### *Freight Traffic*

The total freight traffic of the eastern region in 1936 was 83 million tons, 45 million on the Est and 38 million on the A.L. By far the most bulky commodity carried was iron ore, of which the Est carried 13.4 million tons and the A.L. 11.5 million tons. These figures do not mean, however, that 25 million separate tons of ore were actually put on the rail, for traffic passing from the Est to the A.L. or vice versa would be counted by both companies. Actually under one-half of the tonnage mined in the Lorraine field touches the railway, the rest being used locally and transported to the furnaces by private lines or aerial ropeways. The ore traffic has three aspects: (i) export to the Franco-Belgian coalfield and to the furnaces just across the Luxembourg border (via Thionville-Bettembourg, Longuyon-Mont St Martin or Longuyon-Mézières-Hirson), (ii) export to the Saar and Ruhr areas of Germany (via Thionville, Trier or Metz-Saarbrücken), (iii) internal movement, especially as between the calcareous ores of

the Briey plateau and the siliceous ores of the Nancy, Metz-Thionville and Longwy areas, which are frequently mixed in the blast furnaces. Fuel—coal and coke—comes next in tonnage; the Est carried 7.6 million tons and the A.L. 12.5 million tons, and the same qualification must be applied to these figures as to those of iron ore, though the traffic between Est and A.L. was less in this case. The three main streams of coal and coke traffic converging on Lorraine are (i) from the northern coalfield via Mézières, (ii) from the Ruhr, (iii) from the Saar and its French extension (Petite Rosselle, La Houve, etc.). It is worth noting that both the ore and fuel traffic entail a considerable mileage of empty wagon running, despite the fact that the two commodities are moving in opposite directions and one might be expected to form a return freight for the other. In actual fact special wagons are mostly employed—all-steel hoppers for ore, different pattern hoppers for coal, and wagons with wire-netting sides for the more frangible coke.

Iron and steel quite naturally take third place—5.0 million tons on the Est and 3.3 million tons on the A.L. This traffic is of course entirely outward from Lorraine, mainly to the northern industrial region with its great engineering works, partly also to the engineering industries of Paris and Alsace (e.g. Mulhouse).

‘Stones’, as usual, occupy a high place by reason of their weight. Granite is quarried for road metal (shaped into setts or ‘pavés’) in the High Vosges, especially in the Gérardmer-Rémiremont area; building stone is quarried from the Corallian and Portlandian limestone of the Meuse valley area; sandstone from the Triassic rocks of the Low Vosges. Lime and cement come from the Lower Jurassic limestones of the Moselle valley, and from the chalk scarp north of Vitry, and chalk is also quarried in the Marne valley between Vitry and Châlons, whilst gypsum is worked in the same valley from Tertiary clays between Château-Thierry and Paris.

Cereals and other foodstuffs do not figure very prominently in the freight traffic of the eastern region, and neither do animals; the Champagne and Alsatian vineyards, however, yield a wine traffic which occupies a very poor third place after the south-eastern and south-western regions.

### *Sheds, Works, Marshalling Yards*

The principal locomotive sheds are shown on Fig. 82 (on which the less important lines are omitted). The larger and more important sheds are indicated by large symbols. The concentration of big depots



and yards around the Lorraine industrial area is noteworthy. The main locomotive works are at Epernay, but the following sheds at least, and possibly some others, are equipped to deal with heavy repairs: (a) on the former Est railway—Noisy-le-Sec, Reims, Mohon, Château-Thierry, Châlons, Bar-le-Duc, Nancy, Blainville, Epinal, Audun-le-Roman, Conflans-Jarny, Troyes, Chaumont, Culmont-Chalindrey; (b) on the former A.L. lines—Thionville (Basse-Yutz), Metz (Sablon), Strasbourg (Hausbergen) and Mulhouse.

The principal carriage and wagon repair depots are at Pantin, Noisy-le-Sec, Romilly, and Mulhouse.

The chief marshalling yards and concentration sidings are also indicated on Fig. 82. The largest yards, employing hump shunting, are at Vaires (completed, with a garden city for the employees, in 1932, to relieve Noisy-le-Sec—capacity 6,000 wagons per day), Lumes (near Mézières), Blainville (near Nancy), Strasbourg (two yards—Hausbergen and Port) and Mulhouse (Nord).

#### SOUTH-EASTERN REGION

The P.L.M. was the largest of the seven systems, totalling nearly 10,000 km. (6,182 miles) of line, almost exactly one-half of which was double track and one-half single track. Despite its great length, however, it only ranked third in respect of both passenger and freight traffic. Apart from the Lyons-St Etienne region it has no great industrial areas within its territory, and its lines serve some of the most thinly populated parts of France, including the Alps, the Jura and the eastern part of the Central Massif. Much of its traffic, however, may be described as 'high-class' and remunerative, especially the long-distance passenger traffic to Switzerland, Italy and the Riviera, and the seasonal freight traffic in 'primeurs' (early vegetables, fruit, etc.) from the Rhône valley and via Marseilles from north Africa to Paris.

The main line is effectively described in the title P.L.M.—Paris-Lyons-Mediterranean; it runs across the scarplands to Dijon and thence down the long Saône-Rhône 'corridor' to Lyons and Marseilles, turning thence eastward to the Riviera and the Italian frontier at Ventimiglia. This line is in effect duplicated by another which diverges from the first in the Paris suburbs, strikes southwards through Nevers to St Germain-des-Fossés, thence south-eastwards via Roanne and St Etienne to the Rhône valley at Givors, after which it follows the right bank of the Rhône to Avignon. From Avignon to Marseilles the main and duplicate lines form a figure 8; the duplicate

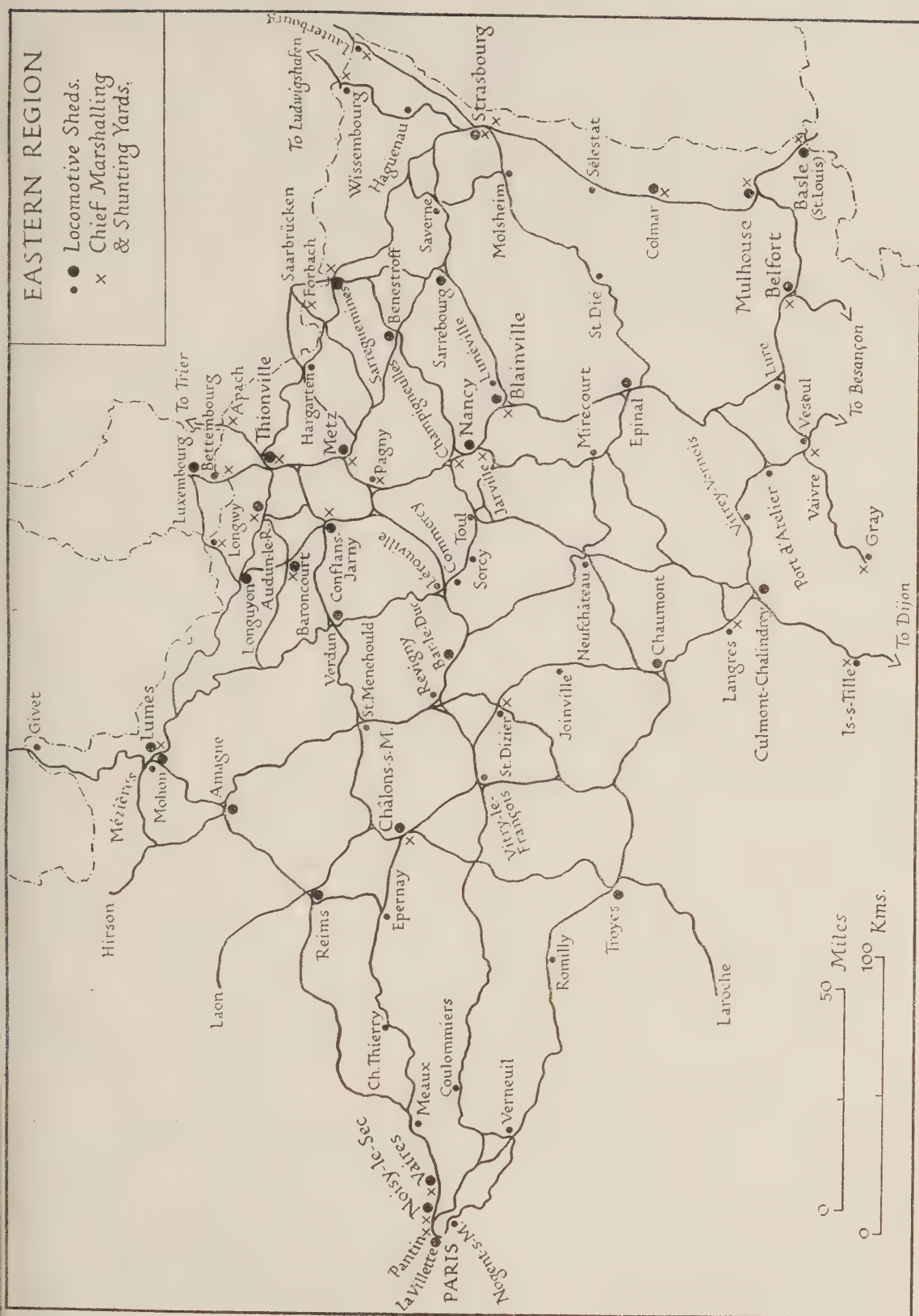


Fig. 82. The main lines of the *Région Est*  
Showing the location of the chief locomotive sheds and marshalling yards.



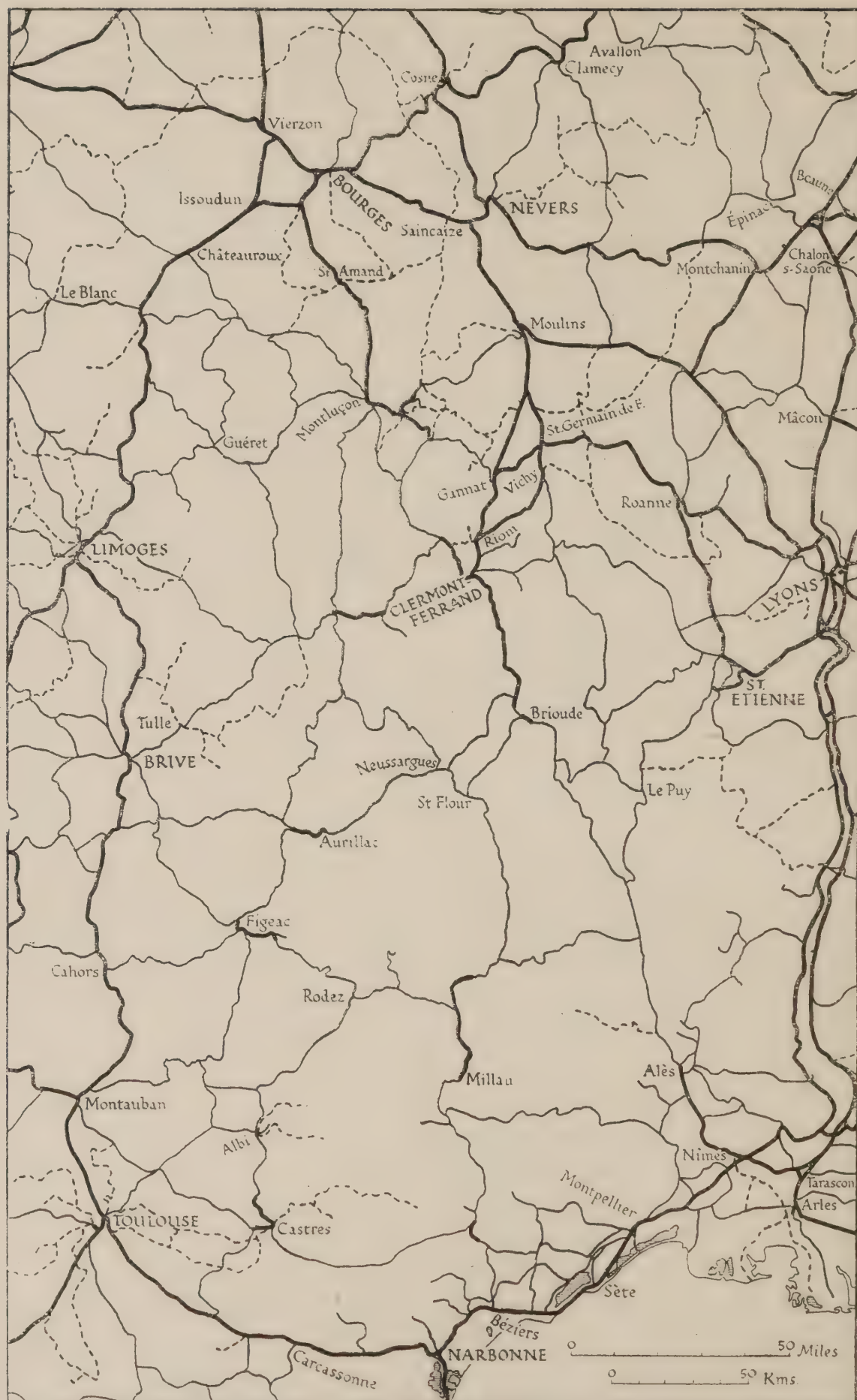


Fig. 83. Railways in south-central France. For key see Fig. 71.



Fig. 84. Railways in south-eastern France. For key see Fig. 71.



crosses the main line at Miramas, strikes the coast at Port-de-Bouc and rejoins the main line at L'Estaque, just before Marseilles. Yet another, but much less important, north-south link is provided by the line which diverges for the 'duplicate' line at St Germain-des-Fossés and runs through Clermont-Ferrand, across the Central Massif and down its steep Cévennes scarp to the Alès coalfield and Nîmes, whence it forks to link up with the Rhône valley on the one hand, at Avignon and Tarascon, and with the Midi line on the other hand, at Montpellier and Sète.

The main lines east of the Saône-Rhône corridor lead either into Switzerland and Italy or else to dead-ends in Alpine valleys. Dijon is the point of divergence for two main trunk lines leading to eight separate destinations: (i) to Dôle, whence one line strikes north-eastwards through Besançon to Belfort and so to Strasbourg or Basle, another runs to Frasné, diverging thence to cross the Swiss frontier at Pontarlier (for Berne) or at Vallorbe (for Lausanne and the Simplon route); (ii) to Bourg and Culoz, whence one line strikes north-eastwards, forking again at Bellegarde for Geneva and Évian-les-Bains, another (worked by electric traction) via Chambéry to Modane and so through the Mt Cenis tunnel to Turin; this line gives off branches at Aix-les-Bains (for Chamonix) and at St Pierre d'Albigny (for Bourg St Maurice). From Lyons an important link connects the Riviera with central Europe, running through Bourg, Lons-le-Saunier, and Mouchard (on the Dôle-Frasné line) to Besançon (for Belfort); another similar link runs to Ambérieu (on the Bourg-Culoz line). South-eastwards from Lyons runs the main line to Grenoble; finally, from Livron a line runs eastwards across the grain of the country to Briançon in the heart of the French Alps.

There are five main links with the south-western region. At Saincaize is collected traffic from western France (Brest, Nantes and Tours) which is passed on eastwards along a useful cross-country line through Le Creusot to Chagny (and so to Dijon), or south-eastwards via Moulins and Paray-le-Monial to Lyons. At Moulins, Gannat and Clermont-Ferrand traffic emanating from south-western France is collected; traffic from Bordeaux destined for eastern France and central Europe passes through Moulins, Paray-le-Monial, Montchanin and Chagny to Dijon; that destined for south-eastern France through Gannat, St Germain-des-Fossés and Roanne to Lyons. Clermont-Ferrand is linked to Bordeaux by the difficult route across the heart of the Central Massif and to Lyons via Vichy and St Germain-des-Fossés.

(i) *Paris-Ventimiglia* (Fig. 85)*Summary*

- (1) Length: 1121 km. (697 miles).
- (2) Track: With exception of Paris suburban area there are: Paris-St Florentin-Vergigny (172 km.), 4 tracks; St Florentin-Vergigny-St Germain-au-Mt d'Or (319 km.), 2 tracks; St Germain-au-Mt d'Or-Chasse-sur-Rhône (41 km.), 4 tracks; Chasse-sur-Rhône-Ventimiglia (589 km.), 2 tracks.
- (3) Maximum permissible axle-load: 18 tons.
- (4) Maximum gradients: 1 : 125 in both directions.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 13 km.
- (7) Marshalling yards: Villeneuve-St Georges, Laroche, St Florentin-Vergigny, Les Laumes-Alésia, Dijon-Perrigny, Chalon-sur-Saône, St Germain-au-Mt d'Or, Lyon-Guillotière, Chasse, Portes, Orange, Avignon, Arles, Miramas, Rognac, Marseilles-Blancarde, Aubagne, La Seyne-Tamaris-sur-Mer, Carnoules, Nice.
- (8) Engine sheds: Paris (Bercy), Villeneuve-St Georges, Melun, Montereau, Sens, Laroche, Tonnerre, Les Laumes, Dijon, Chagny, Chalon-sur-Saône, Mâcon, St Germain-au-Mt d'Or, Lyon-Vaise, Lyon-Mouche, Portes, Livron, Pierrelatte, Orange, Avignon, Tarascon, Arles, Miramas, Marseilles, Marseilles-Blancarde, Toulon, Carnoules, Cannes-la-Bocca, Nice-St Roch, Ventimiglia.

For the first 9 miles the line follows the Seine, to the great junction of Villeneuve-St Georges; then, instead of continuing thus along the meandering valley, it strikes across part of the Brie limestone plateau, rising and falling with a maximum gradient of 1 : 200, rejoining the Seine at Melun. Again avoiding the sweeping and deep-cut meanders it cuts through the Forest of Fontainebleau (on Fig. 85, F.S. = Fontainebleau Sands), dropping to the river valley once more before Montereau. The crossing of the Cretaceous and Jurassic scarplands is less easy to effect than that of the more level Tertiary plateaux of the Paris region, and in consequence for the next 130 miles the line keeps strictly to river valleys. For 45 miles to Laroche it hugs the Yonne, passing through the chalk scarp before Joigny, then for 50 miles it follows the narrower Armançon valley, thus effecting a passage through the Portland limestone scarp at Tonnerre and through the Corallian limestone scarp shortly before Nuits-sous-Ravières; beyond Aisy the Oze valley, cut down into Liassic clays beneath the 'oolitic limestone' plateau of Langres, is followed for 30 miles to its head. Over the 70 miles from Montereau to Tonnerre the rise is gradual, the steepest gradients being a few short stretches at 1 : 250; thenceforward gradients of 1 : 200 are frequent, and the final 8-mile climb to the summit at Blaisy-Bas is mostly at 1 : 125. A tunnel  $2\frac{1}{2}$  miles long carries the line across the Channel-Mediterranean watershed, and a steep descent of the eastward-facing limestone scarp of the Côte d'Or, including 10 miles of almost continuous 1 : 125,





brings the line to Dijon, on the edge of the broad Saône trough. The next 340 miles to Marseilles represent a gradual descent of the Saône-Rhône valley, though the gradient is by no means even, and especially between Dijon and Lyons is actually quite undulating, with frequent stretches both up and down at 1 : 200; beyond Lyons there are very few gradients steeper than 1 : 333. Between Dijon and Lyons the line keeps fairly close to the western edge of the great trough known as the Bresse depression, hugging the foot of the Côte d'Or scarp as far as Chalon, and thence following the Saône river. Between Lyons and Avignon the Rhône valley is closely followed, though as the line keeps to the left or eastern side of the valley the river, which hugs its right bank, is seldom encountered except in those parts where the valley, cutting through harder outcrops of crystalline rock or Mesozoic limestone, is almost gorge-like in character, e.g. in the neighbourhood of Vienne, at Tain, and between Loriol and Montélimar. The left bank course means, however, that all the strong, snow-fed Alpine tributaries of the Rhône, with their broad deltaic fans of ancient and modern alluvial debris, have to be crossed as they are about to enter the main stream; thus the Isère is crossed 5 miles before Valence, the Drôme just before Loriol, the Aygues just before Orange and the Durance just beyond Avignon. At Arles, on the edge of the Rhône delta, the line turns abruptly eastwards across the alluvial plain to Miramas, and shortly afterwards runs for nearly 20 miles along the edge of the lagoon known as the Etang de Berre. The limestone ridge of L'Estaque is crossed in the long Nerthe tunnel and the line emerges on the Mediterranean coast, reaching Marseilles, 536 miles from Paris, a few miles farther on.

The line from Marseilles to Ventimiglia falls into three sections. Between Marseilles and Toulon its course is at first inland, rising and falling across the east-west limestone ridges, and then along the coast; the ruling gradient—which is of frequent occurrence—is 1 : 125. From Toulon via Carnoules to Fréjus the line again runs inland, following in a remarkable way the depression etched out in the outcrop of Permian rocks between the coastal crystalline massif of Maures and the folded sedimentaries of the outermost Alpine chain. A large proportion of this section is also at 1 : 125. From Fréjus to the Italian frontier the line follows a sinuous course along the Riviera coast, with frequent cuttings, occasional tunnels and many bridges over deep-cut torrents. The altitudinal range of the line is small, but the track is distinctly undulating and gradients steeper than 1 : 200 are of fairly frequent occurrence, the steepest being 1 : 140 (Plate 63).



*Axle-loads* (Fig. 70)

The main lines of the south-eastern region were equipped, in 1938, the latest date for which information is available, for 18-ton axle-loads. Paris to Ventimiglia, Paris to Clermont-Ferrand, Dijon to Belfort, Vallorbe and Geneva, Lyons to Modane, Lyons to St Germain-des-Fossés, and Tarascon to Sète, were all so equipped, with a few other important links and branches. The remainder of the system could take 16-ton axle-loads.

*Electrified Lines* (see Fig. 69)

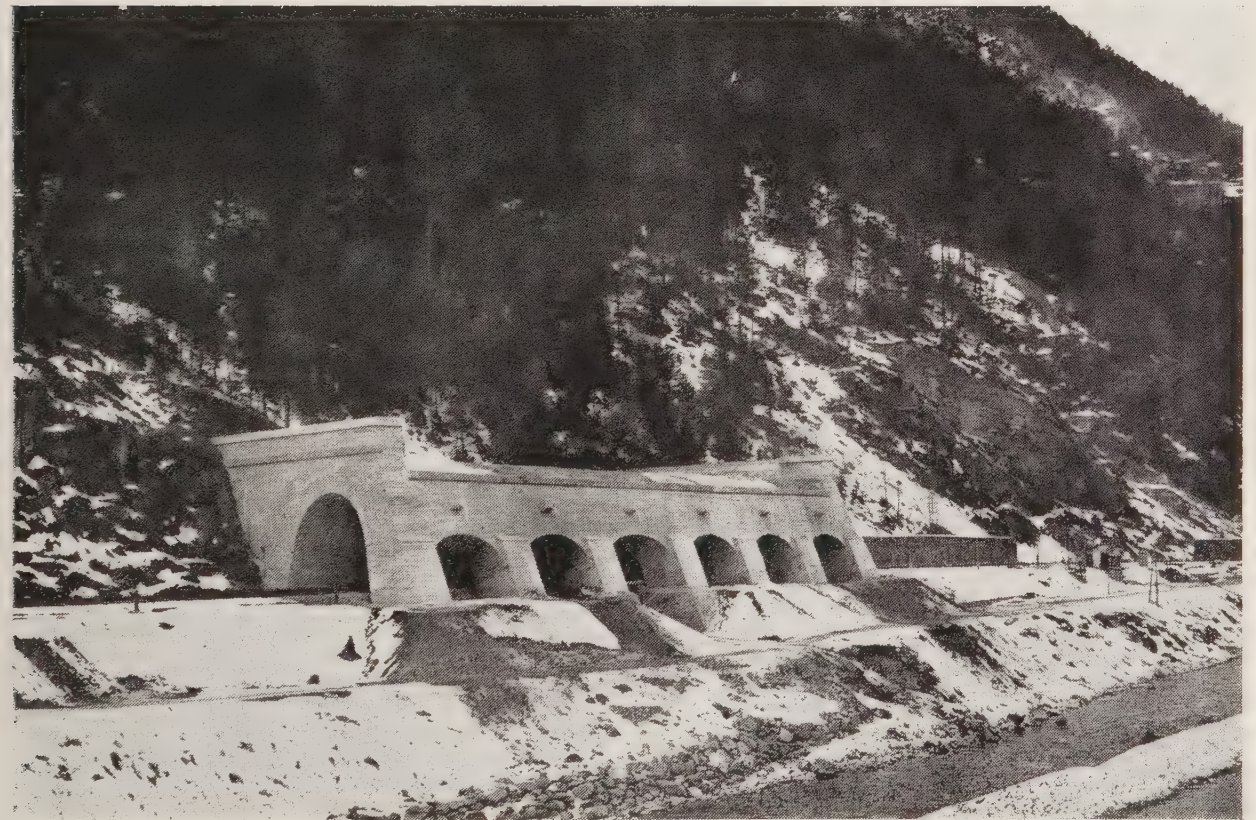
The Culoz-Modane section of the Mt Cenis route to Italy, which contains gradients of 1 : 33 and many sharp curves, was the first main line in France to be electrified; work commenced in 1923. It uses current at 1,500 V. d.c. picked up from a third rail; the current comes immediately from the large transformer station at Albertville, but ultimately from seven hydro-electric plants owned by the Ugine-electrochemical concern (Plates 61, 62; see also Vol. III, Chapter v of this Handbook).

The Chamonix valley narrow-gauge line has been electrically operated since 1908; current is derived from two hydro-electric power stations owned by the P.L.M. railway and situated on the river Arve at Servoz and Chavants.

*Passenger Traffic*

Passenger traffic on the P.L.M. railway in 1936 totalled nearly 83 millions. Of these, 93·2 % travelled third class, 5·8 % second class and 0·8 % first class; the receipts from third class fares, however, only amounted to 66 % of the total, a lower figure than on any other line. This result is clearly produced by the volume of 'luxury' travel on the great international trunk lines which form part of the P.L.M. system—a fact which is also demonstrated by figures which show that the average length of journey per passenger on the P.L.M. in 1936 was 72 km., or more than twice the average for any other system except the Paris-Orléans-Midi, for which the figure was 59½ km., whilst the averages for first, second and third class passengers were respectively 323, 205 and 61 km. Apart from the Paris suburban traffic, the quite considerable local movement in the Lyons-St Etienne area, and the general passenger traffic on all parts of the system, the major traffic streams are from Paris to the Riviera and to the south-eastern frontier of France (Pontarlier, Vallorbe, Geneva and Modane), streams which are reinforced from the eastern region at Is-sur-Tille





Plates 61, 62. Protection against avalanches on the P.L.M. Culoz-Modane line  
Plate 61 (above) shows the line being cleared after an avalanche had completely smothered it. Plate 62 (below) shows the same spot after the construction in 1938 of a protecting gallery, which allows the avalanches to slide over its roof into the river.





Plate 63. The P.L.M. line along the Riviera coast

Photograph taken from above Beaulieu-sur-Mer, between Nice and Monte Carlo. The railway is almost at sea level; the *Corniche* road which parallels it lies farther inland and at a much higher level. (See p. 338; also Plate 67 in vol. 1 of this Handbook.)



Plate 64. The Bidassoa bridges

The Bidassoa river marks the Franco-Spanish frontier, between Hendaye and Irun. On the left is the road bridge; in the centre is the Spanish broad-gauge railway track; on the right the French standard-gauge railway.



and Belfort; a smaller stream runs from Paris to the spas and other centres of the Central Massif—Vichy, Clermont-Ferrand, etc. The Paris suburban traffic extends as far as Melun (45 km.) and Corbeil (33 km.), with outer-suburban services as far as Montereau (79 km.) and Montargis (118 km.); it is not as heavy as that of the western and northern regions.

The fact that the Swiss, Italian, Alpine resorts and Riviera traffic all has to use the main line between Paris and Dijon makes this one of the most intensively used stretches of track in France—especially at night, for most of the big expresses are sleeping-car trains, which under normal circumstances leave Paris in a continuous stream during the evening hours and arrive from the south-east in the early morning. Dijon between 10 p.m. and 4 a.m. was probably the busiest station in Europe during those hours. Much of the line has four tracks; the double-tracked section from Melun via Fontainebleau to Montereau is effectively quadrupled by the parallel line on the opposite side of the Seine valley, and thus the only two-track sections are between St Florentin (107 miles from Paris) and Les Laumes-Alésia (160 miles), and from Blaisy-Bas summit (178½ miles) to Dijon (195 miles).

### *Freight Traffic*

Freight traffic in 1936 totalled 38 million tons, of which nearly 10 million tons consisted of coal and coke—partly coal derived from the northern field and being distributed southwards for domestic, industrial and locomotive purposes, and partly coal from the several small fields which are served by the P.L.M. line, namely, Le Creusot, St Etienne and Alès. The second item, 2·8 million tons, is iron and steel; this resulted largely from the traffic in pig-iron and steel to the great engineering centres of Le Creusot and St Etienne and the outward traffic in finished products from those centres. 'Stones' occupy third place. Road metal is quarried from the granite and other igneous rocks of the eastern part of the Central Massif, as in the regions of Roanne, Cusset and St Etienne; ballast gravels come from the Bas Dauphiné region; building stones are got from the Jurassic limestones of the Rhône valley south-east of Ambérieu, from the scarp edge west of Chalon-sur-Saône and from many places in the Great Oolite Plateau of Langres, also limestone and marble from Provence. Lime and cement come from Jurassic limestones in the region of Nevers, in the Rhône valley between Chambéry and Ambérieu, and in the Grenoble area, from the Cretaceous limestones of Le Teil and Montélimar, and from the Cretaceous and Jurassic



limestones of Provence, e.g. L'Estaque and the ranges behind Toulon. Fourth place is occupied by wine; the Rhône valley and the Mediterranean region form one of the major areas of production of 'vin ordinaire' for home consumption and a considerable traffic results, amounting to 2.4 million tons in 1936 (Plate 60). Cereals and flour are important—2 million tons—partly by reason of the import traffic of the port of Marseilles. Of the other foodstuffs the most interesting item is the 'primeurs'—early vegetables and fruit—which has given rise to a highly organized special traffic of a seasonal character, which is worth analysing in a little detail.

The P.L.M. railway used justifiably to advertise itself as 'Réseau des primeurs'. Five thousand special trains a year, comprising 125,000 wagons (mainly of special insulated or refrigerator types) loaded with half a million tons of produce, certainly represented a considerable item in the organization of the railway company. The producing regions are the Mediterranean littoral and the Rhône-Saône valley, whilst about a quarter of the total traffic is derived from North Africa (via Marseilles-Arenc) and there is some also from Spain (via Sète); the chief consuming centres are Paris, the Lyons-St Etienne region and the industrial north, but large quantities pass also, especially in the summer, to the seaside resorts, the spas (e.g. Vichy) and the Alpine tourist centres. Whilst the collection of produce from a few areas is fairly easy therefore, its distribution to a multitude of diverse destinations constitutes a traffic problem of considerable magnitude.

Although the maximum traffic intensity is between June and September, there is actually an almost continual flow of produce from one region or another. In January, vegetables and fruit arrive from North Africa; in February and March this traffic increases and is supplemented by asparagus, artichokes and other salad vegetables from Var, Durance and Avignon; in April, green peas from Algeria are followed by those from the Comtat region (Avignon-Orange), and by Algerian haricots and early tomatoes; May sees the haricot season in full swing (and it lasts until September). From June to September fruits are added to the spate of vegetables: in June come Comtat strawberries, Nîmes cherries, Rhône valley peaches, and the first grapes from Algeria; in July, apricots, plums, apples and pears from the same regions; in August, table grapes from Var, Bas Languedoc and Comtat. There is a sharp falling off in the traffic in October, but there are nuts from Ardèche, the Cévennes and Dauphiné, and the first oranges arrive at Marseilles.

In November the traffic is at a minimum, but new potatoes begin

to arrive from Algeria, and in December the first winter vegetables appear, together with flowers from the Mediterranean coast (Côte d'Azur), and the North African and Spanish orange traffic increases.

The perishable nature of the produce necessitates rapidity of transit, and under normal circumstances the produce would be collected from the growers during the day, packed in special vans which would then be marshalled into complete trains for various destinations, some of which would be reached in time for the early-morning markets. Most of the marshalling and dispatching of trains was done at the yards at Avignon and Chasse (Fig. 86), with Lyon-Brotteaux, La Voulte and Rognac playing much smaller parts. The focal position of Chasse made it the really vital point in the whole 'primeurs' service; on the main Marseilles-Paris line just south of Lyons, it lies at the junction of lines to St Etienne, the Bourbonnais and Burgundy, and communicates via Lyon-Guillotière with Besançon, Geneva and Modane, and via Givors with the right bank of the Rhône (which is an important line for the 'primeurs' traffic, since the main left-bank line is apt to be congested with night passenger expresses). The bulk of the marshalling work is done between 7.30 p.m. and 3.30 a.m. At the Paris end of the main traffic stream the trains are unloaded at Bercy (see Fig. 101), and much of the produce then passes by lorry to Les Halles, the Paris equivalent of Covent Garden.

In 1937 the P.L.M. possessed nearly 9,000 special vans for 'primeurs' traffic, representing almost four-fifths of the total French stock of this class of vehicles, and including some 400 still further specialized vans for use on the Dunkirk-Dover ferry service.

A particularly interesting item in the freight traffic of the south-eastern region is animals, mainly sheep. In 1936 over 2,100,000 animals were carried by the P.L.M., a far greater number than by any other system. This traffic is essentially the modern expression of the seasonal transfer of animals and their shepherds between summer and winter pastures which has been a characteristic feature of the farming system of parts of France for hundreds of years, and which is known as 'transhumance'. The long journeys on foot from the plains of Provence and the lower Rhône to the Alps in the early summer, however, are largely a thing of the past, and the sheep and goats are now driven to the railway stations at Arles, Pont d'Avignon and Nîmes, for example, and sent by train to destinations in the Tarentaise and Maurienne regions such as Bourg-St Maurice and Modane, returning southwards when the Alpine pastures cease to be available



in the late autumn. This is not only a matter of convenience but is also a factor in reducing the incidence of foot-and-mouth disease, which was formerly spread over wide areas by the migrating flocks.

### *Sheds, Works, Marshalling Yards*

The location of all locomotive sheds except very small ones is indicated on Fig. 86 (which omits the less important lines within the region). The larger depots (roughly those accommodating more than about fifty engines) are emphasized by larger symbols, and the sheds serving the electrified Culoz-Modane line are distinguished by the letter *E*.

The chief locomotive repair works are at Paris (Bercy), Nevers, Lyons (Oullins), Arles and Nîmes.

The chief centres for carriage and wagon repairs are Villeneuve-St Georges, Dijon (Perrigny), Lyons (Oullins, La Mouche and Perrache), Clermont-Ferrand, Arles and Marseilles (Prado).

The chief marshalling yards and concentration sidings are also shown on Fig. 86. The largest of these, employing hump shunting, are at Villeneuve-St Georges, in the Lyons area (St Germain-au-Mont d'Or, Guillotière, Vénissieux, and Chasse), and at Miramas.

## SOUTH-WESTERN REGION

The combination in 1934 of the third largest (Paris-Orléans) and fifth largest (Midi) of the seven major railways of France resulted in the formation of a system which in mileage considerably exceeded that of any other (11,706 km., 7,274 miles). The geographical character of the combination, however, prevented it from playing the part in passenger and freight transport which its length of line would seem to warrant. Only the A.L. system, with but one-fifth the mileage, had a smaller passenger traffic, and the freight tonnage of the P.O.-Midi was actually the smallest of all the systems. The same geographical factors, however, gave the system a unique distinction; the existence of abundant possibilities for the development of hydro-electric power in the Pyrenees and in the Central Massif made electrification an obvious step, especially in view of the distance of south-west France from major coalfields. The 500-mile main line from Paris via Bordeaux to the Spanish frontier is electrified throughout, as are also the 336-mile transverse main line of the Midi from Bayonne to Sète, and numerous other lines (see Fig. 69).

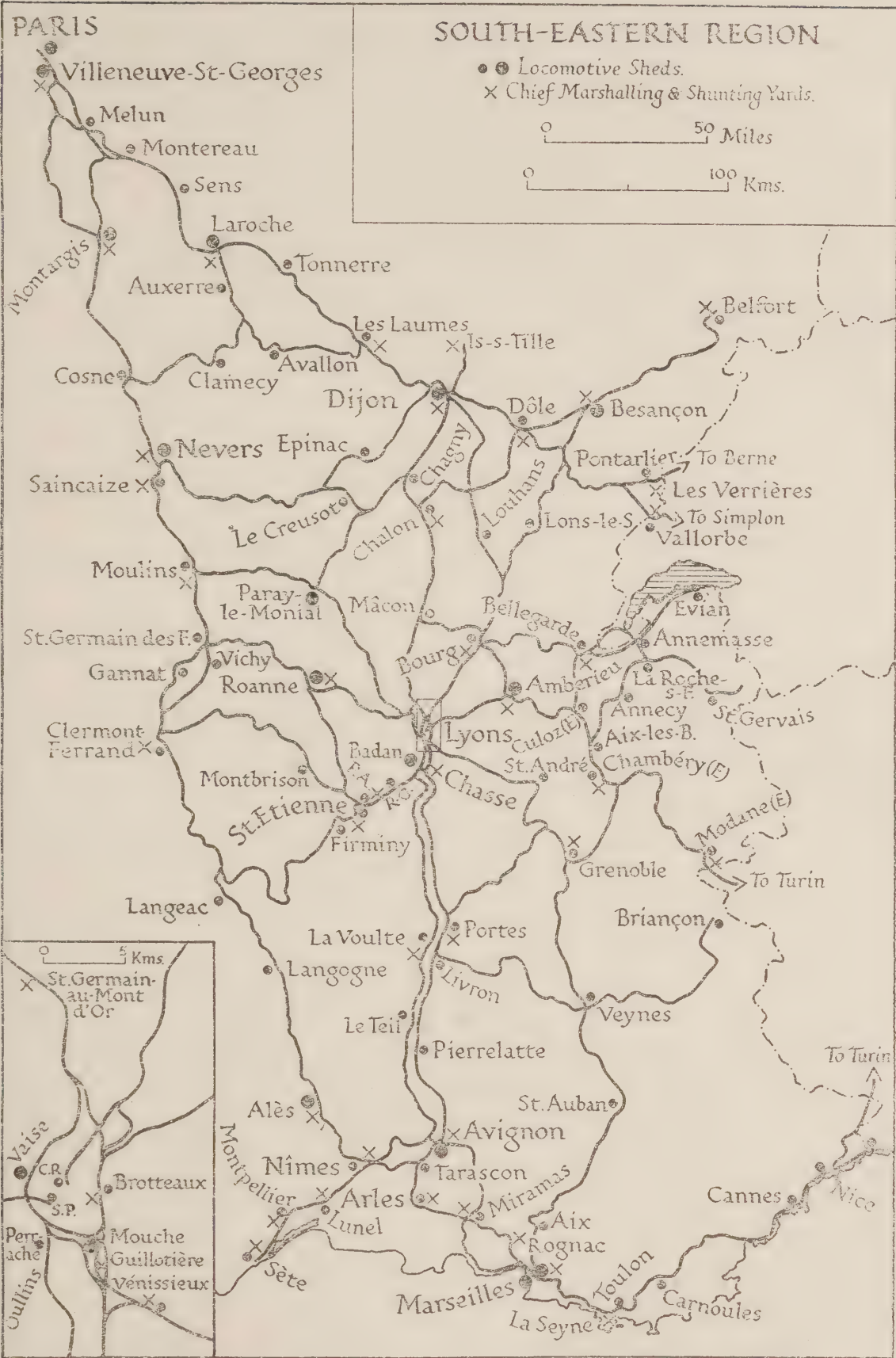


Fig. 86. The main lines of the *Région Sud-Est*

Showing the location of the chief locomotive sheds and marshalling yards.  
C.R. Croix-Rousse; S.P. St Paul; P.A. Pont de l'Âne; R.G. Rive-de-Gier.



The main lines of the south-western region fall naturally into two groups, those from Paris to the Spanish frontier and those linking south-western France with the centre and south-east. Of the former the most important is the 'Sud Express' route from Paris via Orléans, Tours, Poitiers, Bordeaux and Bayonne to the Spanish frontier at Hendaye (for Madrid). A second, more difficult line, which crosses the western part of the Central Massif, leaves the first at Orléans, and proceeds via Vierzon, Limoges, Brive and Montauban to Toulouse, continuing thence via Foix to the Spanish frontier at Puigcerda (for Barcelona); only the Brive-Montauban section of this line remains steam-operated. A branch of this trunk diverges at Limoges for Périgueux, Agen and Tarbes, whilst an alternative route between Brive and Toulouse runs through Figeac. A third south-bound line leaves the second main line at Vierzon and proceeds via Montluçon, Aurillac and Millau to Béziers; the last section of this line, from Neussargues to Béziers, which includes a very steep (1 : 30) descent of the Cévennes scarp, is electrically operated (see Fig. 69).

The transverse lines run from Tours via Vierzon and Bourges to Saincaize (carrying traffic from Brittany and Nantes to the P.L.M. line); from Angoulême via Limoges and Montluçon to Moulins and Gannat (linking La Rochelle and Royan with the P.L.M. line); from Coutras (on the main Bordeaux line) via Périgueux and Brive to Clermont-Ferrand (for Lyons, Geneva, etc.); from Bordeaux via Agen, Toulouse and Carcassonne to Narbonne, whence connexion is made via Béziers with the P.L.M. at Sète, and via Perpignan with the Spanish line to Barcelona at the frontier station of Port-Bou; and from Bayonne via Tarbes to Toulouse, the last line having connexion with the main Bordeaux line also via the Puyôo-Dax and Tarbes-Morcenx lines. Finally, mention must be made of the numerous electrified branch lines which run from the Bayonne-Toulouse line to the market towns and tourist centres of the Pyrenees. One of these, commencing at Pau, crosses the mountains by the Somport tunnel to Canfranc, whence a Spanish line leads to Saragossa; of the others the chief are those to Pierrefitte, Bagnères-de-Bigorre and Luchon.

### (i) *Paris-Hendaye* (Figs. 88, 89)

#### *Summary*

(1) Length: 820 km. (510 miles).

(2) Track: Paris (Quai d'Orsay)-Austerlitz (6 km.), double track; Paris (Austerlitz)-Étampes (54 km.), four tracks; Étampes-Toury (33 km.), double track; Toury-Cercottes (23 km.), three tracks; Cercottes-Les Aubrais (7 km.), four tracks; Les Aubrais-Hendaye (697 km.), double track.

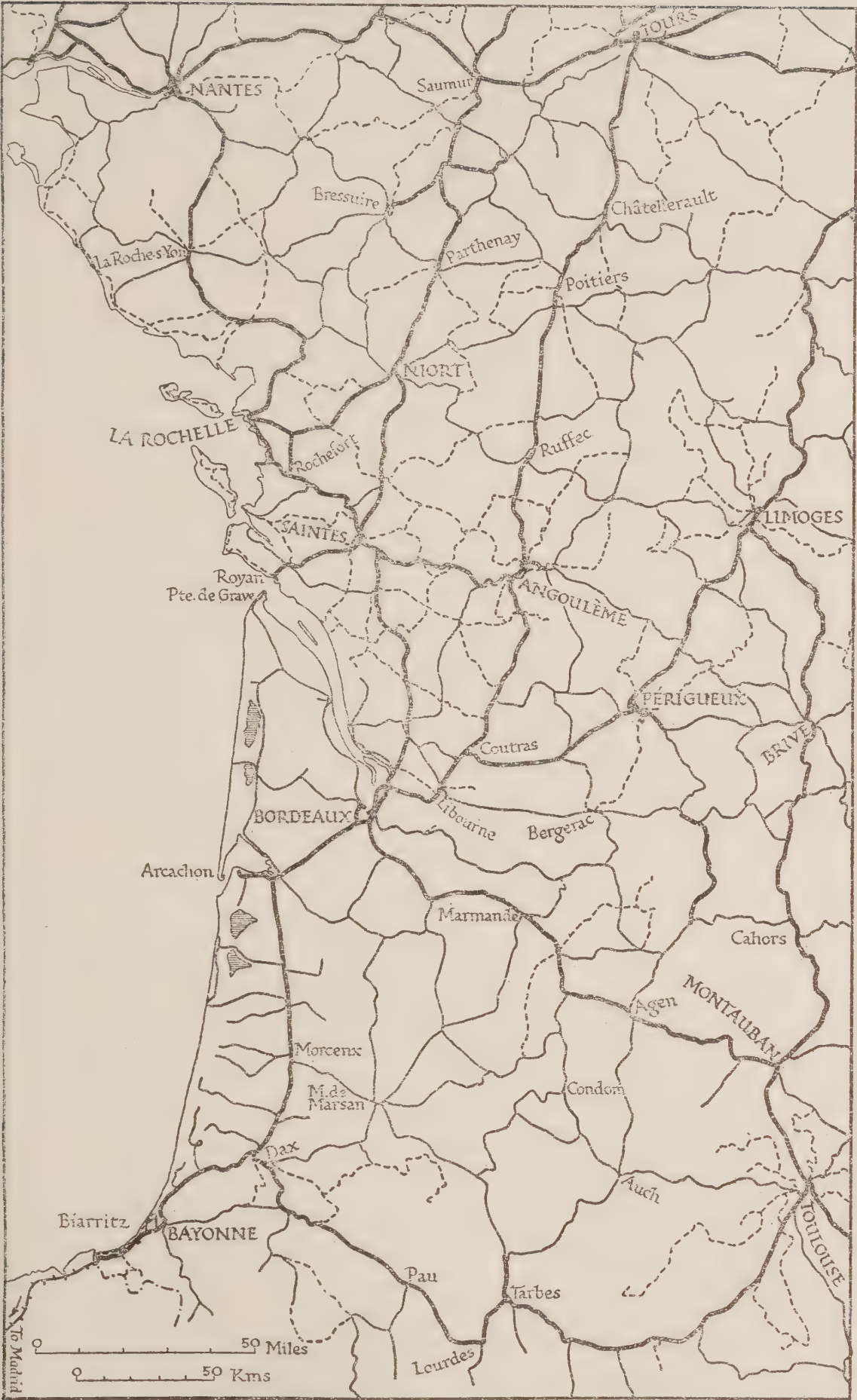


Fig. 87. Railways in south-western France. For key see Fig. 71.



(3) Maximum permissible axle-load: Paris (Quai d'Orsay)-Austerlitz, 16 tons; Paris (Austerlitz)-St Pierre-des-Corps, 18 tons; St Pierre-des-Corps-Poitiers, 16 tons; Poitiers-Angoulême, 18 tons; Angoulême-Lamothe, 16 tons; Lamothe-Bayonne, 20 tons; Bayonne-Hendaye, 16 tons.

(4) Gradients: Paris-Les Aubrais—maximum against south-bound trains, 1:125, against north-bound trains, 1:166; Les Aubrais-Bordeaux—maximum against south-bound trains, 1:192, against north-bound trains, 1:166; Bordeaux-Hendaye—maximum in both directions, 1:100.

(5) Traction: Electric.

(6) Maximum distance between stations: 14 km.

(7) Marshalling yards (see Fig. 93): Paris-Austerlitz, Juvisy, Bretigny, Les Aubrais, St Pierre-des-Corps, Coutras, Bordeaux-St Jean, Morcenx, Bayonne, Hendaye.

(8) Engine sheds (see Fig. 93): Paris-Austerlitz, Juvisy, Bretigny, Étampes, Les Aubrais, Blois, St Pierre-des-Corps, Poitiers, St Saviol, Angoulême, Coutras, Bordeaux-St Jean, Lamothe, Morcenx, Dax, Bayonne, Hendaye.

This line encounters no serious relief obstacles in the whole of its 510 miles; it makes use of the Poitou 'Gate' to pass from the Paris basin to the Aquitaine basin and has very few gradients steeper than 1:200 until it crosses the foot-hills of the Pyrenees between Bayonne and the Spanish frontier. From the Quai d'Orsay terminus the first 2 miles are underground, along the banks of the Seine to the Austerlitz station, which is reached by a short climb to the surface at 1:91. Thence to the junction of Juvisy the line continues to follow the Seine, after which it climbs first (at 1:285) on to the western extremity of the Brie limestone plateau, and beyond Étampes more steeply (1:125) on to the level surface of the Beauce limestone plateau which it traverses for 30 miles, in general on a gently descending gradient of 1:500–1:1,000, to Les Aubrais, the station for Orléans. Orléans is served by a short branch line and the main line by-passes it. For the next 70 miles the line follows the Loire valley; for the first 35 miles to Blois its course lies on the northern side of the valley well above river level, and the steepest gradient is 1:333; beyond Blois it descends by a short stretch at 1:200 to the bottom of the valley, and thereafter gradients are negligible except for a short rise and fall at 1:285 near Vouvray where the river Loire has to be bridged. Tours, like Orléans, is by-passed and the town is served by a short branch from the important junction of St Pierre-des-Corps. A rise and fall mostly at 1:200 carries the line across the Champeigne plateau between the Cher and Indre rivers, and a similar rise and fall across the plateau of St Maure brings it to the chalk country which rims the southern side of the Paris basin.

The river Creuse is crossed at Le Port-de-Piles, and thenceforward the valleys of the Vienne and its tributary, the Clain, carry the line for 50 miles through Poitiers, well into the heart of the 'Plaines du

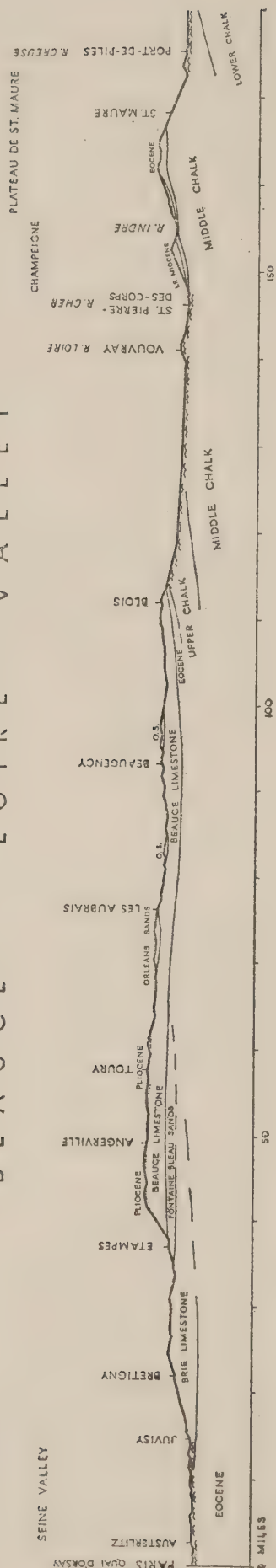
Poitou'; the ascent is on the whole gentle, though there are a few short stretches at 1 : 200. The Jurassic belt, mainly limestone with occasional patches of infertile Tertiary sands, which separates the Paris and Aquitaine basins is crossed for 50 miles to Angoulême without making use of river valleys, for the latter are few and far between and mostly deeply incised. The Charente is crossed at Luxe (and a short stretch of 1 : 166 is necessary to get down to the valley bottom), and then the Corallian limestone plateau of Angoumois. Over the whole of this 50-mile section the line is more undulating, with more frequent 1 : 200 gradients than hitherto.

Beyond Angoulême the broad rolling chalk upland, known on its northern side as the Champagne Charentaise and on its southern or dipslope side as La Double, is crossed for 30 miles; the rise to the summit contains several miles at 1 : 192, the descent, after several miles at 1 : 200 (including a mile-long tunnel), flattens out as the level plains and broad valleys of the Tertiary basin of Aquitaine are approached. The last 40-odd miles to Bordeaux-St Jean follow the rivers Dronne, Isle and Dordogne; there are bridges over the first two of these, and a long 100-arch viaduct across the wide plain of the Dordogne; the track is gently undulating, but the last mile contains a gradient of 1 : 166 in descending to the level of the river Garonne, which is crossed just before St Jean station.

The first section of the Midi line lies across the Landes de Bordeaux, the interfluvium between the Garonne and Arcachon bay; gradients of 1 : 200 and 1 : 250 carry the line to the level of the low plateau, and the fall to Lamothe is mostly at 1 : 250. There follows a remarkable 40-mile stretch, absolutely straight, through the pinewoods of the Landes to Morcenx. Gradients are slight, only in one or two places exceeding 1 : 500. The southern part of the Landes is crossed between Morcenx and Dax; this section is less straight and more undulating; there are many miles at 1 : 200 and two short stretches of 1 : 166, and the last 12 miles before Dax is a continuous descent, mostly at 1 : 200, to the Adour valley, which is then followed for 9 miles. Instead of following the Adour to Bayonne the railway takes a slightly more direct course, reaching the coastal sand-dunes at Labenne and continuing southwards for 12 miles on an almost level course. The Adour is bridged at Bayonne, and the remaining 22 miles to the Spanish frontier, across the Pyrenean foot-hills, are sharply undulating and tortuous, the greater part being steeper than 1 : 200 with many short stretches at 1 : 100, and numerous tunnels and bridges over coastal torrents. Occasionally, as at Guéthary, the line is within sight



# BEAUCE LOIRE VALLEY



# PLAINES DU POITOU CHARENTES

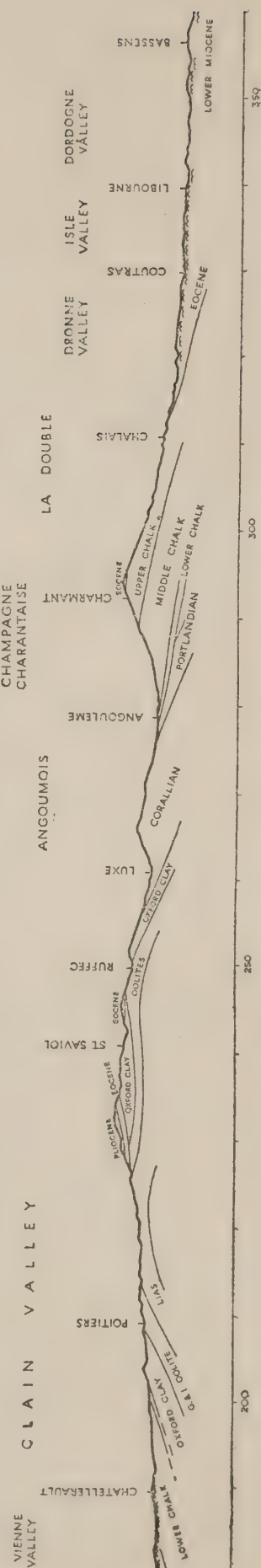


Fig. 88. Gradient profile, Paris-Hendaye (first section)

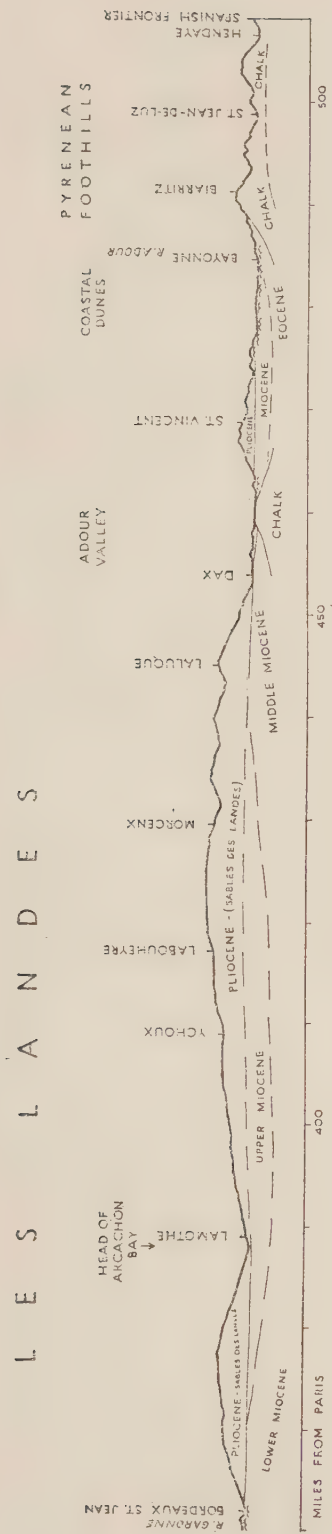


Fig. 89. Gradient profile, Paris-Hendaye (conclusion)

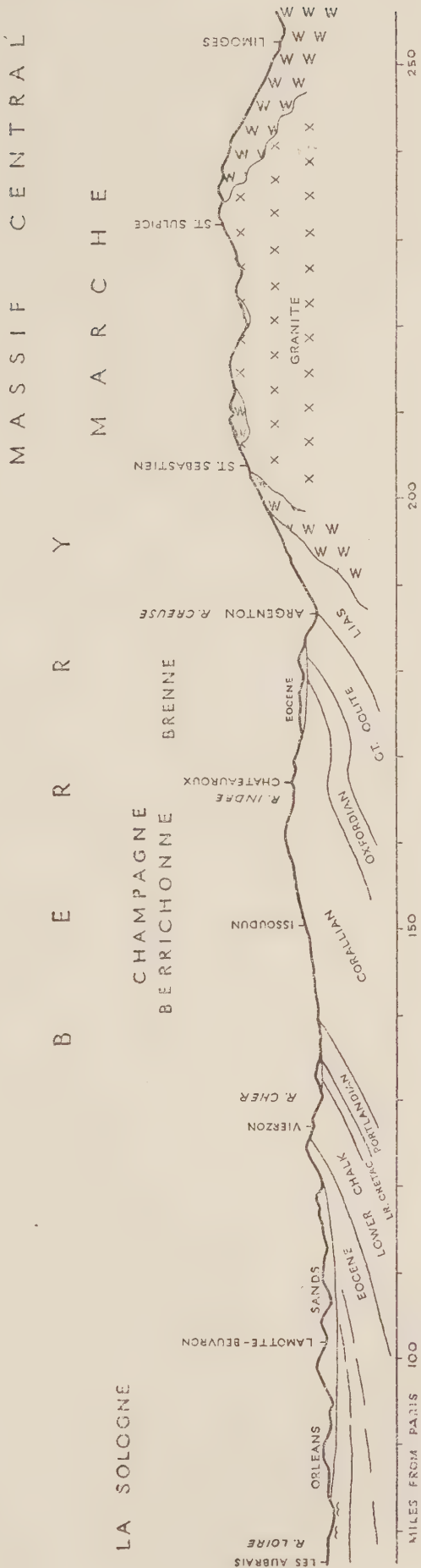


Fig. 90. Gradient profile, Orléans (Les Aubrais)-Narbonne (first section)



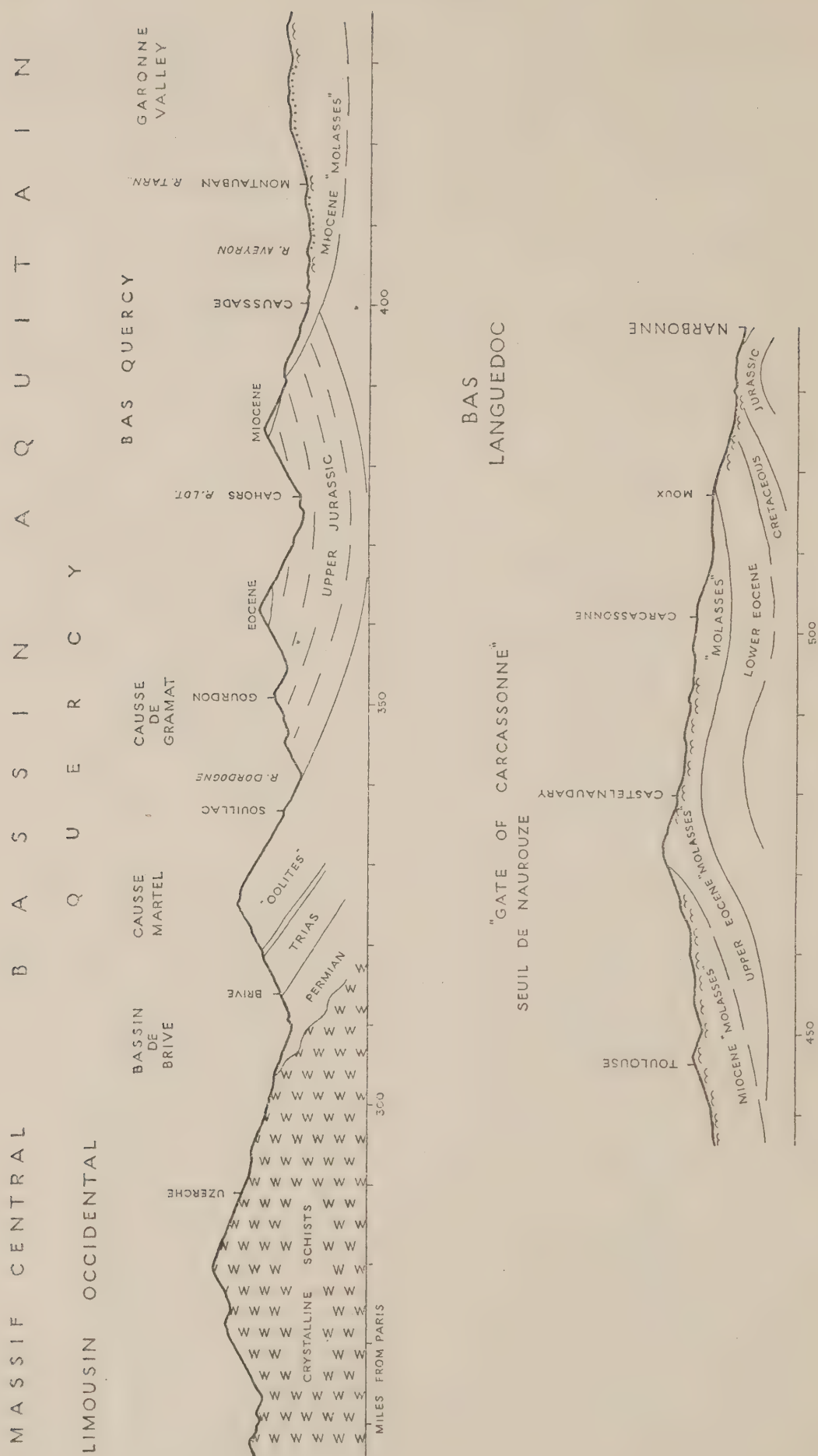


Fig. 91. Gradient profile, Orléans-Narbonne (conclusion)

of the sea. Hendaye is the French frontier station; the sidings and the line across the Bidassoa bridge to the Spanish station at Irun are equipped for both standard (4 ft. 8½ in.) and Spanish (5 ft. 6 in.) gauges (Plate 64).

(ii) *Paris-Orléans-Limoges-Narbonne* (Figs. 90 and 91)

*Summary*

- (1) Length (Les Aubrais-Narbonne): 743 km. (462 miles).
- (2) Track: Double track throughout.
- (3) Maximum permissible axle-load: Les Aubrais-Brive, 18 tons; Brive-Narbonne, 16 tons.
- (4) Gradients: Les Aubrais-Toulouse section—maximum gradient in both directions, 1:100; Toulouse-Narbonne section—maximum gradient in both directions, 1:200.
- (5) Traction: Les Aubrais-Brive, electric; Brive-Montauban (163 km.), steam; Montauban-Narbonne, electric.
- (6) Maximum distance between stations: 17 km.
- (7) Marshalling yards (see Fig. 93): Les Aubrais, Vierzon, Limoges, Brive, Montauban, Toulouse, Narbonne.
- (8) Engine sheds (see Fig. 93): Les Aubrais, Vierzon, Châteauroux, Argenton, St Sulpice-Laurière, Limoges, Brive, Cahors, Montauban, Toulouse, Castelnau-d'Aud, Carcassonne, Narbonne.

Diverging from the Paris-Bordeaux line at Les Aubrais, this line crosses the western part of the Central Massif and passes through the 'Gate of Carcassonne' to the Mediterranean coast. After crossing the Loire it traverses the low sandy plateau of Sologne for nearly 40 miles, undulating and with considerable sections at 1:200. The edge of this Tertiary plateau is descended, at 1:170, to the important junction of Vierzon, in the Cher valley. The chalk country, which looms so largely in other parts of the periphery of the Paris basin, is here almost sandwiched out between the Sologne and the Jurassic limestone plateau of Berry. The Champagne Berrichonne is crossed in a gradual ascent (steepest 1:330) through Issoudun, and between Châteauroux and Argenton the eastern end of the infertile, lake-studded region known as Brenne, floored by Tertiary sands, is traversed. The descent to the Creuse valley at Argenton is at 1:160; beyond here commences the steep climb (mostly 1:100) to the Central Massif, and for the next 200 miles the line is steeply graded, with many long sections at 1:100. The traverse of the Central Massif takes the form of two broad rises and falls, the first across the mainly granite country of Marche to Limoges, and the second across the crystalline schists of the western Limousin to Brive. Much of the descent to Limoges and most of the Limoges-Brive section are at 1:100, or only slightly less steep. Some miles before Brive the ancient rocks of the Massif are left behind, and the next 60 miles or



so represent a crossing of the Jurassic limestone scarplands of Quercy which border the Aquitaine basin on its north-eastern side. From the richly cultivated Permo-Triassic basin of Brive the line ascends, mostly at 1:100, to the limestone Causse Martel which forms the interfluvium between the Corrèze and the Dordogne; the descent to the latter valley includes nearly ten miles of continuous 1:100. Between the Dordogne and the Lot more limestone terrain is crossed, and gradients of 1:100 continue to dominate the line. From Cahors to Caussade the last and lowest of the plateaux—Bas Quercy, largely covered by Tertiary limestone—is crossed, and here the steeply graded section ends. The next 40-odd miles to Toulouse lie across the ancient and recent alluvia of the Garonne and its affluents the Aveyron (crossed at Albi) and the Tarn (crossed at the junction of Montauban).

Beyond Toulouse there is a gentle rise, ending at 1:250, to the summit of the 'Seuil de Naurouze' (better known perhaps as the 'Gate of Carcassonne'), the Atlantic-Mediterranean watershed; this is followed by 65 miles of slightly less gradual descent (though with nothing steeper than 1:200) through Castelnaudary and Carcassonne to Narbonne, in part along the alluvial tracts deposited by tributaries of the Aude, in part across the sandy conglomerates ('molasse') of the Carcasse.

### *The Trans-Pyrenean lines*

The Hendaye and Cerbère lines round the ends of the Pyrenees were opened in 1864 and 1878 respectively, but although as far back as 1865 no less than twelve possible routes across the range had been surveyed by engineers it was not until 1928-9 that the linking of France and Spain by trans-Pyrenean railways was effected. The first actual crossing of the Pyrenean watershed had been provided in 1911 by the narrow-gauge electrified line from Villefranche to Bourg-Madame, prolonged in 1927 to La Tour de Carol—but this was all within French territory, for the frontier departs in places from the watershed. The Somport line, linking Pau and Saragossa, was opened in July 1928, and the Puymorens line, which should link Toulouse and Barcelona, in July 1929. Both of these lines are electrified on the French side; neither has succeeded in achieving any great importance; the steep gradients and the curvature (minimum radius 200 m.—656 ft.) make fast travel quite impossible; the break of gauge at the frontier is an effective deterrent to international traffic, and the political situation has not encouraged such traffic.

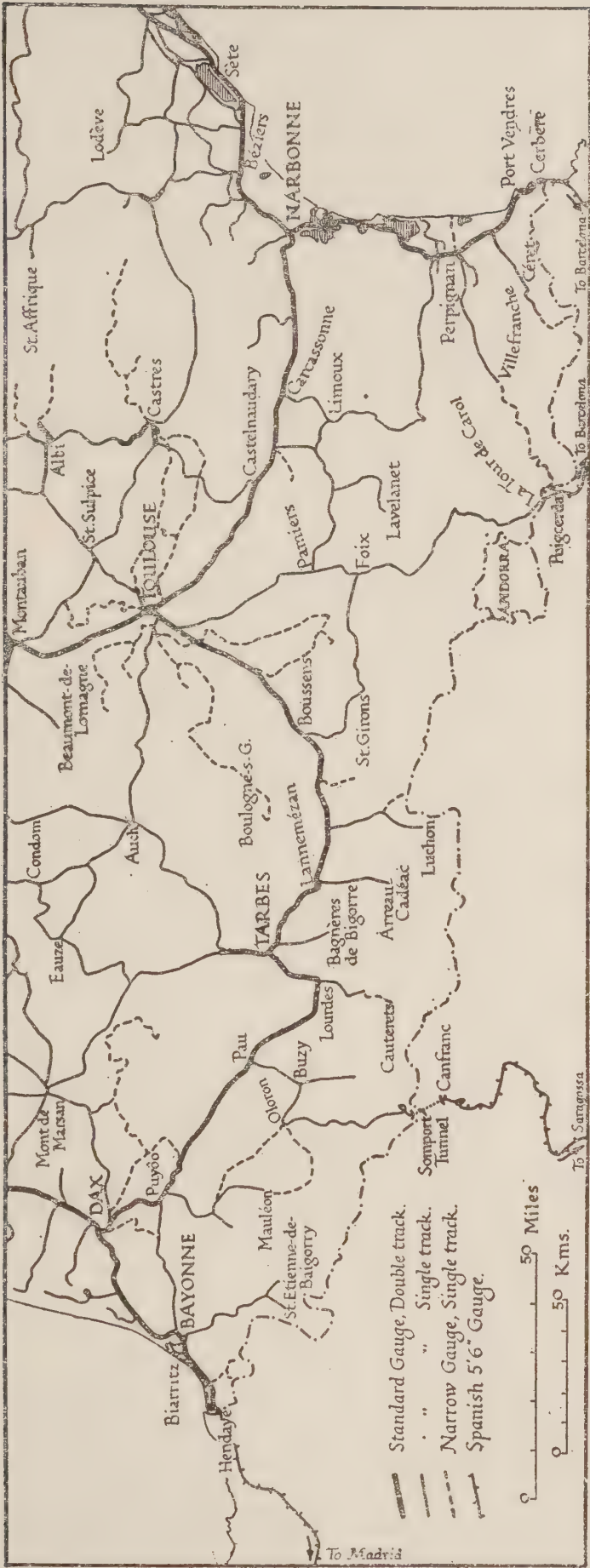


Fig. 92. Railways in southern France, showing connexions with Spanish lines



The Somport line ascends the Aspe valley; the gradient from Bédous to Etsaut averages  $1 : 28\frac{1}{2}$ , steepening thence to the summit, at  $1 : 23$ . There are sixteen tunnels, including a spiral 1,793 m. (1,961 yd.) long, and the summit of the line is reached at 1,211 m. (3,973 ft.) above sea-level in the Somport tunnel, 7,875 m. long (8,612 yd., or nearly 5 miles). From the international station of Canfranc at the Spanish end of this tunnel, the steam-operated 'Norte' railway, 5 ft. 6 in. gauge, leads down at  $1 : 50$  towards Jaca and so to Saragossa. The line connects two agricultural districts across a mountainous area, and its international traffic is very slight indeed.

The Puymorens line ascends the Ariège valley from Ax-les-Thermes, mostly at  $1 : 25$  and with eleven tunnels, one of which is a mile-long spiral, to the watershed, which is crossed at 1,567 m. (5,141 ft.) above sea-level in the Puymorens tunnel, 5,533 m. long (6,051 yd., nearly  $3\frac{1}{2}$  miles); the descent to the French frontier station of La Tour de Carol is slightly less steep, and has no tunnels. The station of La Tour de Carol was built in anticipation of the development of a considerable international traffic which was expected to develop when the authorized conversion of the Spanish line to Barcelona to standard 4 ft.  $8\frac{1}{2}$  in. gauge was completed. Its vast halls have never yet been used for their proper purpose.

From a military point of view these trans-Pyrenean lines have not the same value as the coast lines, for the gradients are extremely severe on both sides of the frontier, being almost at the limit of normal adhesive operation, and any interruption of the electricity supply would greatly hinder traffic. The estimated capacity of the lines for southward-moving traffic is eighteen trains per 24 hr., as compared with seventy-two for the Hendaye line and forty-eight for the Cerdère line. Their prospects for international traffic are very poor. After all, about two-thirds of the international trade between France and Spain has in normal times been conducted by sea, and these two difficult lines can hardly hope to compete for the remaining one-third with the Hendaye and Cerdère routes.

### *Electrified Lines* (see Fig. 69)

No less than 2,828 km. (1,757 miles) of line in the south-western region are electrically operated. The equipment consists of overhead wires which supply current at 1,500 V. d.c. The current is generated at a number of hydro-electric stations in the Pyrenees and in the Central Massif, and is also available, during the midsummer months

(when the volume of the Central Massif rivers, and so their output of power, is much reduced), from the thermal-electric station at Gennevilliers on the outskirts of Paris (Fig. 101); it is distributed at voltages of between 90,000 and 220,000 to the main transformer stations. These key stations, which step down the current to the voltage required by the railway, are shown on Fig. 69; those fed from the Central Massif hydro-electric stations of Eguzon (on the Creuse), Marèges and Coindre (both on the upper Dordogne) are at Chevilly (Paris), Chaingy (Orléans), Les Epines-Fortes (Tours), Chaumont (Poitiers), Eguzon and Marèges; those fed from the Pyrenean power stations in the Ossau and Aure valleys are at Fléac (Angoulême), Pessac (Bordeaux), Dax, Jurançon (Pau), Hourat, Lannemezan, Portet-St Simon (Toulouse) and St Victor. The narrow-gauge line in the eastern Pyrenees, from Villefranche-Vernet-les-Bains to La Tour de Carol, is operated at 850 V. d.c. with third rail; current is supplied by the Fontpedrouse hydro-electric plant.

#### *Axle-loads (Fig. 70)*

The infrastructure of the P.O.-Midi lines was more variable than that of any other system, partly no doubt due to the very considerable reconstructions which have been undertaken as an accompaniment of the programme of electrification. The use of heavy electric locomotives tends to demand a stronger permanent way than was necessary for the steam locomotives which they replace, and in consequence long stretches of the Midi main lines between Bordeaux and Pointe de Grave (Verdon), Bayonne and Sète were laid with track capable of taking 20-ton axle-loads whilst much of the remainder, and also a good deal of the P.O. main lines, were equipped for 18-ton loads. Reconstruction and relaying were proceeding apace, and whilst Fig. 70 represents the situation in 1938 it is possible that some sections, e.g. Tours-Bordeaux, have since been 'stepped up' from the general standard of 16 tons to the higher 18-ton standard.

#### *Passenger Traffic*

Passenger traffic on the P.O.-Midi system in 1936 amounted to 74 millions; this figure and those for the different classes of traffic—first 0.6 %, second 6.1 %, third 93.2 %—are closely comparable with the P.L.M. statistics, though the proportion of the total receipts derived from third class was much higher, at 77 %, than on the P.L.M. The general geographical situation of the two systems is not dissimilar. Both have Paris suburban traffic; spas and other tourist



centres and small industrial towns are found in both eastern and western sections of the Central Massif; Alpine resorts are balanced by Pyrenean resorts; Biarritz and St Jean-de-Luz may perhaps be regarded as a miniature Riviera, whilst international traffic with Spain is a small counterpart of the P.L.M. traffic with Switzerland and Italy.

Paris suburban traffic is not great; there is really only one service, running to Bretigny (36 km.) and forking thence, to Étampes (60 km.) on the main line and to Dourdan (60 km.), the limit of electrification on the secondary line to Tours. The service formerly worked from the Luxembourg terminus to Limours has been taken over by the Paris Métropolitain as far as Massy Palaiseau, whilst the end of the line, from St Rémy to Limours, is substituted by road transport.

### *Freight Traffic*

The absence of large industrial centres within the south-western region is responsible for the smallness of the freight traffic. The 1936 total of under 28 million tons for the P.O.-Midi was less than that of any of the other systems. The most important item, as usual, is coal, of which over 5 million tons were carried; some of this no doubt was British coal imported at Bordeaux and Nantes, for the small coalfields at Commentry, Decazeville and Carmaux distribute but small quantities by rail. The electrification of the main line had much reduced the demand for locomotive fuel—the P.O. section alone reckoned a saving of 455,000 tons of coal a year and the Midi almost as much—so there is little possibility of an increase in coal traffic. The second item on the list is one which distinguishes the P.O.-Midi from the other systems; it is wine. Several of the major wine-producing districts of France fall within the south-western region, such as the Bordeaux country, the Loire valley, Bas Languedoc, and the brandy areas of Charentes and Armagnac. The wine traffic is a specialized business, employing special containers. Other commodities connected with agriculture loom largely, fertilizers and cereals being next in order of tonnage.

‘Stones’ are less important than on other lines, but the traffic includes road metal from the Central Massif (Limousin region, especially the Vienne valley), building stones from the Cretaceous limestone of the Charente valley below Angoulême, marble from the Pyrenees. Lime and cement are obtained from the Jurassic and Cretaceous limestones of the north-eastern flanks of the Aquitaine basin, from Corallian limestone at La Rochelle and from Tertiary

limestones near Bordeaux. As in the south-eastern region animal traffic, especially on the Midi section of the south-western region, is heavy, and for the same reasons. 'Transhumance' between the Mediterranean lowland and the Central Massif, and to a less extent between the plains of Aquitaine and the Pyrenees, now takes place very largely by rail instead of on foot, and in 1936 over  $1\frac{1}{4}$  million animals, mainly sheep and goats, were carried by the P.O.-Midi system.

### *Sheds, Works, Marshalling Yards*

The principal steam and electric locomotive sheds are indicated on Fig. 93 (on which only the more important lines of the system are shown). The average size of the sheds in the south-western region is probably much smaller than in the northern and eastern regions, for example, and the larger symbols on Fig. 93 refer to sheds the normal capacity of which is more than about fifty engines. The chief locomotive works are at Paris (Ivry), Tours and Périgueux, the last named dealing only with steam locomotives, the other two with both steam and electric. The main carriage and wagon repair depots are at Paris, Orléans, Tours, Limoges and Bordeaux, and special wagon repair shops are associated with the marshalling yards of Juvisy, Les Aubrais, St Pierre-des-Corps, Montluçon, Bordeaux, Périgueux and Limoges.

The chief marshalling yards are also shown on Fig. 93. The largest yards, employing hump shunting, are at Juvisy, Les Aubrais, St Pierre-des-Corps, Limoges and Bordeaux-St Jean.

## WESTERN REGION

The state-owned system in western France comprised a considerable mileage of line, almost 9,600 km. (5,953 miles), a figure exceeded only by the P.L.M. and by the combined P.O.-Midi system. The territory served, however, being almost entirely agricultural and in parts thinly populated, was the least productive of traffic of any large region of France, there being neither industrial freight traffic nor any considerable volume of international passenger traffic. The system originated in 1878 with the state purchase of several insolvent lines, to which the equally insolvent Ouest railway was added in 1908. State administration was not as efficient as it might have been, partly owing to the absence of continuity of control—between 1908 and 1928, for example, no less than twenty-two successive Ministers of Public Works were responsible for the railway—and it was not until



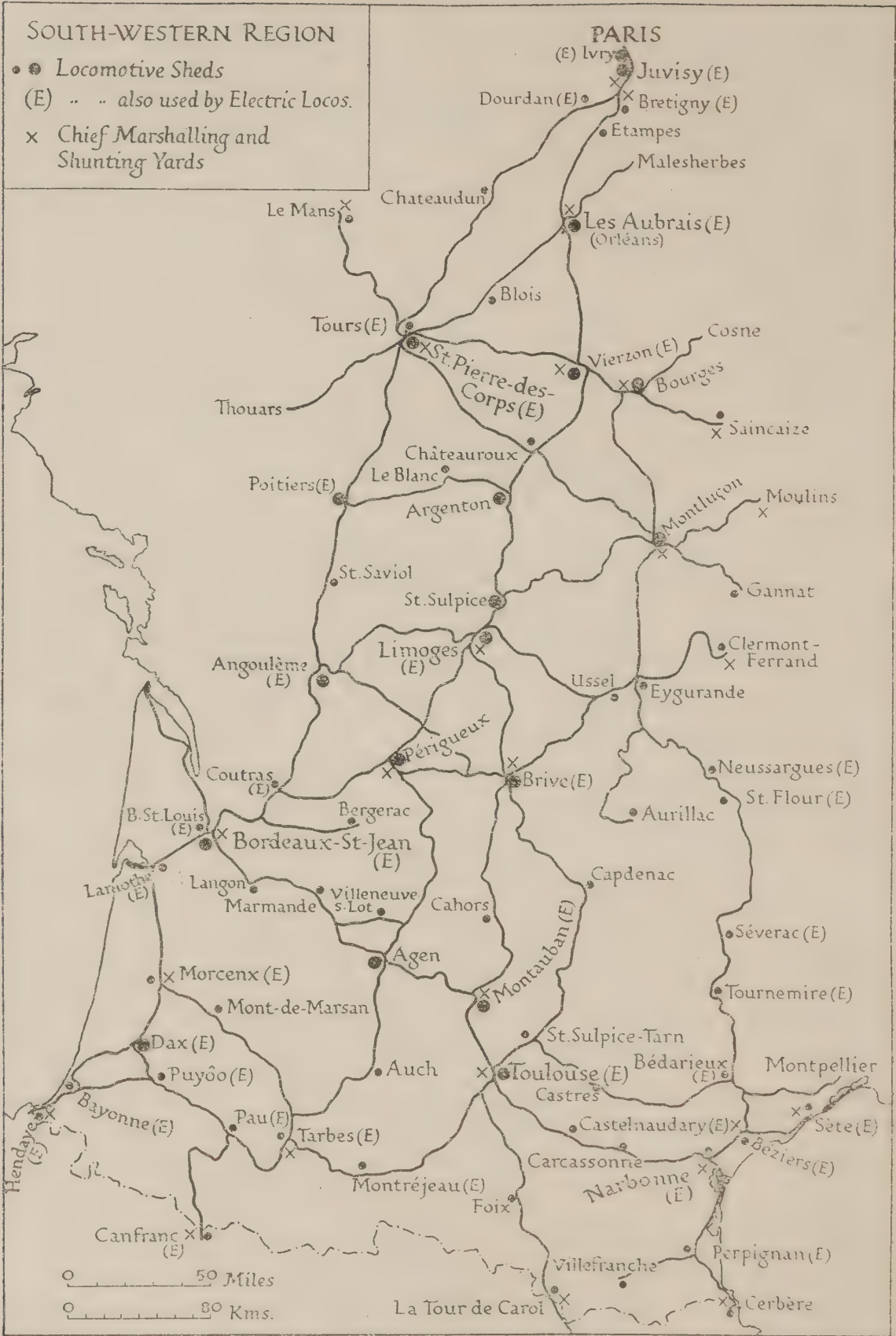


Fig. 93. The main lines of the Région Sud-Ouest  
Showing the location of the chief locomotive sheds and marshalling yards.

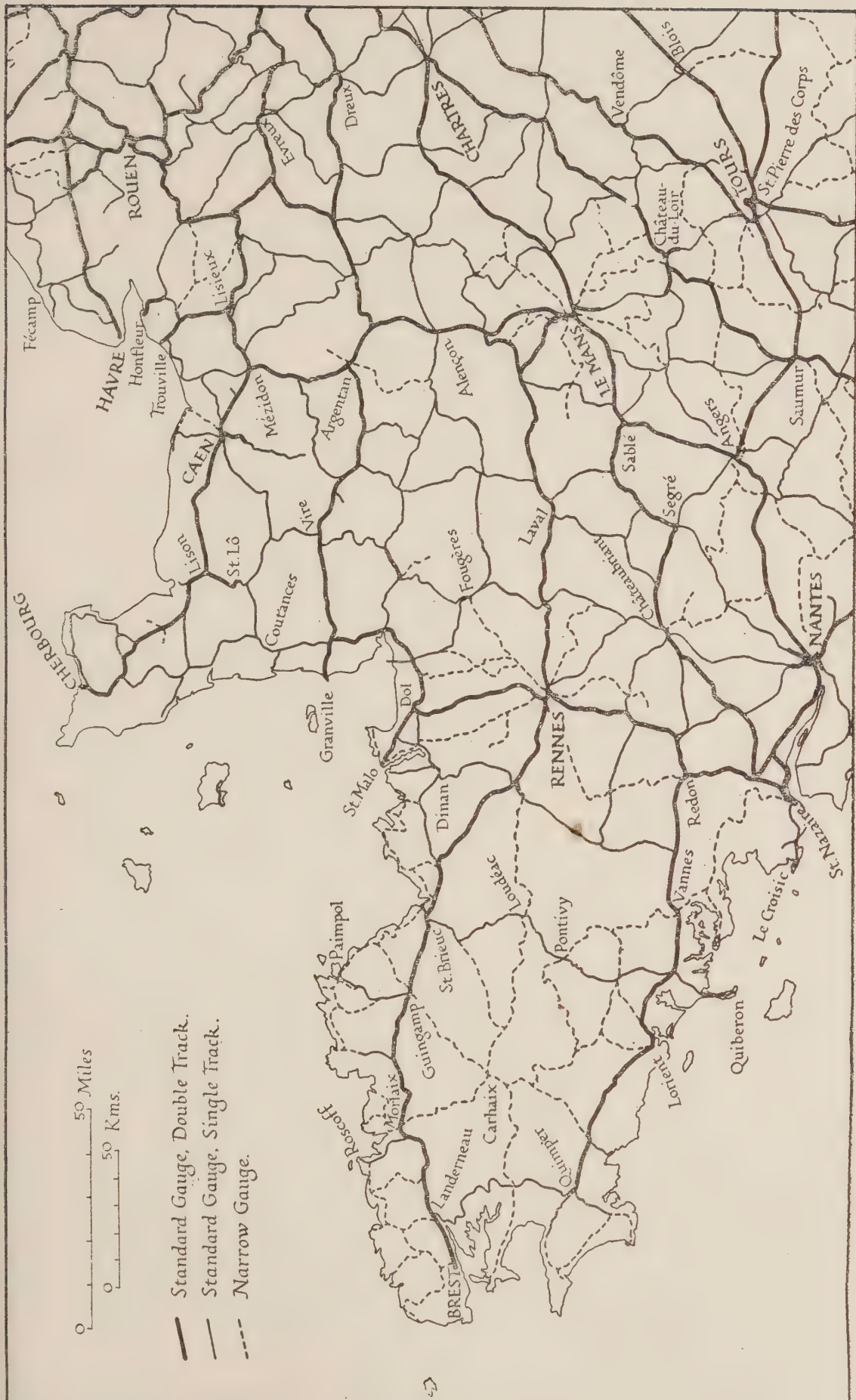


Fig. 94. Railways in western France



1929 that a decree freeing the administration from political interference and the appointment of a particularly energetic general manager, in the person of M. R. Dautry, paved the way for what might almost be described as the metamorphosis of a system which had acquired an unenviable reputation for inefficiency and poor equipment. Freight traffic in 1936 was the lowest of any of the major systems except the P.O.-Midi, and although the passenger traffic was actually the greatest of all the systems, being greater in fact than that of the Est and P.L.M. railways combined, this result was entirely due to the vast Paris suburban traffic which the local electrified lines carried to and from the termini of St Lazare and Invalides.

The main lines of the western region radiating from Paris are five in number, and the last of these has several important branches. From the St Lazare terminus three main lines depart, one to Dieppe (via Pontoise), one to Rouen and Havre, and a third diverging from the second at Mantes, to Cherbourg, with a branch to the seaside resort of Trouville-Deauville. From the Montparnasse terminus run the lines serving western France; the two main lines diverge at Versailles, one running almost due west to the seaside resort Granville, the other serving Chartres, Le Mans, Rennes, St Briec and Brest. From the latter an important line diverges at Le Mans for Angers, Nantes (for St Nazaire), Vannes, Quimper and Brest, and an alternative (though little used) route to Bordeaux, other than the P.O. main line, is provided by the line which runs from Chartres through Saumur, Niort and Saintes to the Gironde estuary, with westward branches to the ports and resorts of Les Sables d'Olonne, La Rochelle, and Royan. The most important cross-country routes within the western region run either north-south or east-west. Of the former the most important is from St Malo via Rennes, Nantes, La Roche-sur-Yon and La Rochelle to Saintes (for Bordeaux), which, linking up with the P.O.-Midi at Bordeaux, provided a useful Channel-Pyrenees route (the 'Côte d'Emeraude-Pyrénées' express) as an alternative to the more usual route from England via the shorter sea route and Paris. Another similar Channel-Spain link (the 'Manche-Océan' express) is provided by the line from Dieppe through Rouen, Serquigny, Alençon and Le Mans, which crosses and makes use of parts of the Cherbourg and Granville main lines. The east-west links join the ports and resorts of western France to the P.O. system and so to central and eastern France; the chief are Angers-Tours, La Rochelle-Niort-Poitiers, and Royan-Saintes-Angoulême.

(i) *Paris-Dieppe* (Fig. 96)*Summary*

- (1) Length: 169 km. (105 miles).
- (2) Track: Double track throughout with exception of Paris suburban area.
- (3) Maximum permissible axle-load: 16 tons.
- (4) Gradients: maximum gradient in both directions, 1 : 100.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 9 km.
- (7) Marshalling yards (see Fig. 98): Achères, Serqueux, Dieppe-Rouxmesnil.
- (8) Engine sheds (see Fig. 98): Batignolles, Achères, Pontoise, Gisors, Gournay, Serqueux, Dieppe-Ville.

This line passes through no towns of importance, and almost its sole function is to give passage to the traffic associated with the Newhaven steamers and that arising out of the fishing industry. It was a cheaply constructed line in the first place, and despite the absence of relief obstacles is quite sinuous and has many 1 : 100 gradients. The first 20 miles lie across the Seine meanders to Pontoise; the river is crossed four times, and between the last of these at Conflans-fin d'Oise and the Oise bridge at Pontoise is a sharp 'hump' with 1 : 100 gradients on each side. There follows a gradual rise, steepening again to 1 : 100 beyond Chars, across the limestone plateau of Vexin, with a sharp descent of the Tertiary escarpment (also 1 : 100) to Gisors. A more gradual climb of the chalk dipslope, making use of the Epte valley, brings the line at Gournay into the 'weald' of Bray, overlooked by chalk scarps on both north and south; the climb continues, with slight interruptions and with numerous short stretches at 1 : 100, to the head of the Epte valley at Serqueux where the outlying line of the northern region from Amiens to Rouen is crossed. Beyond Serqueux the Béthune valley is followed through the chalk plateau to the sea; the descent is steep at first, 1 : 100, but flattens out, and is occasionally interrupted; the last few miles from Arques-la-Bataille to Dieppe are level.

(ii) *Paris-Cherbourg* (Fig. 95)*Summary*

- (1) Length: 371 km. (230 miles).
- (2) Track: Double track throughout with exception of Paris suburban area.
- (3) Maximum permissible axle-load: 16 tons.
- (4) Gradients: maximum gradient in both directions, 1 : 100.
- (5) Traction: Steam.
- (6) Maximum distance between stations: 14 km.
- (7) Marshalling yards (see Fig. 98): Achères, Mantes-Gassicourt, Evreux, Mézidon, Caen, Lison, Cherbourg.
- (8) Engine sheds (see Fig. 98): Batignolles, Achères, Mantes-Gassicourt, Evreux, Conches, Serquigny, Lisieux, Mézidon, Caen, Lison, Cherbourg.



"LIMON"-COVERED PLATEAU  
OF EASTERN NORMANDY

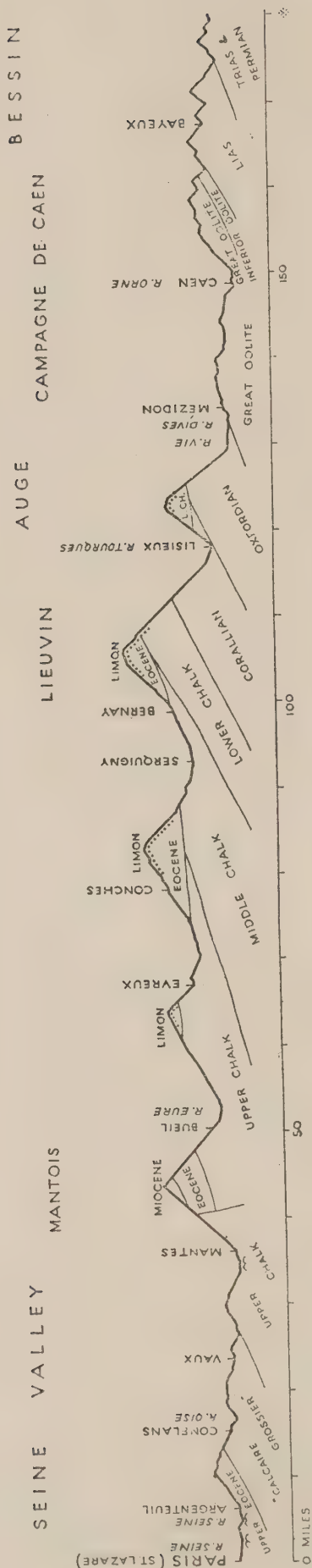


Fig. 95. Gradient profile, Paris-Cherbourg

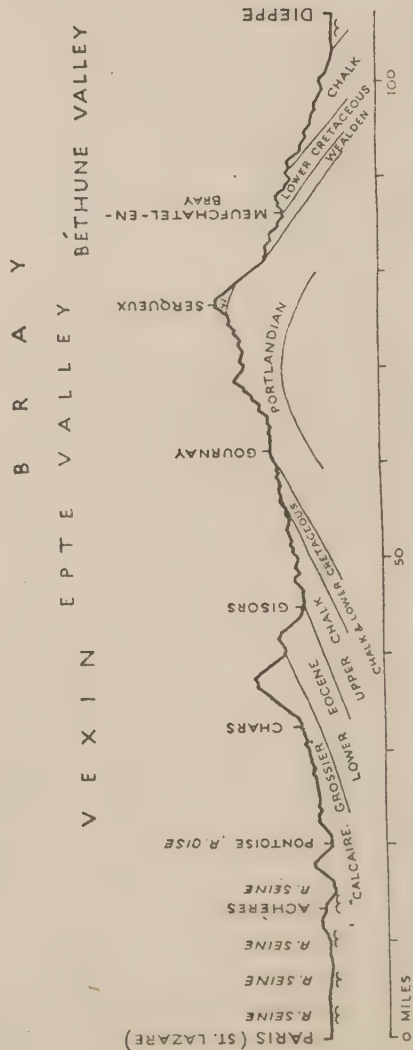
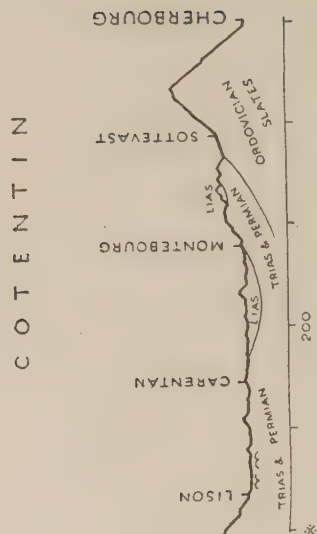


Fig. 96. Gradient profile, Paris-Dieppe



This 230-mile line is an extremely accidented one, with a ruling gradient of 1 : 100 and many quite long stretches steeper than 1 : 150. Thus the haulage of heavy transatlantic boat expresses was not an easy task, and it was for this reason that the Etat railway developed a series of large 4-8-2 engines a decade or so ago (Plate 69). The first 36 miles to Mantes coincide with the Havre route, but the alternative route on the north bank of the Seine via Argenteuil, rather more undulating, is shown on the profile. From Mantes to Lisieux, 82 miles, the line traverses the loam-covered plateau of eastern Normandy, and as the line runs east-west and the deep-cut valleys run south-north there is a succession of rises and falls across the interfluves. A steep rise at 1 : 111 from the Seine valley at Mantes is followed by a descent at 1 : 143 to the Eure valley, which is followed for a few miles; then another ascent (1 : 153–1 : 222) and descent (1 : 125) to the Iton valley at Evreux. The Iton valley is followed for a few miles, and then comes another rise (1 : 161–1 : 156) and a fall (1 : 125) to the Rille valley, which is followed to Serquigny; thence up the Charentonne valley to Bernay and over the plateau once more (up at 1 : 125, down at 1 : 143) to Lisieux. Rising from Lisieux at 1 : 100, the edge of the chalk plateau is at last crossed, and a steep descent, also at 1 : 100, carries the line across the fertile clay vale known as the 'pays d'Auge' to the Jurassic limestone country which wraps round the eastern side of the Breton massif. Gentle undulations across the plateau bring the line to Caen, where the deeply cut Orne valley is crossed. The scarped edge of the Caen limestone plateau is crossed 10 miles farther on, and the Liassic clay terrain, known as the Bessin, is traversed obliquely in a series of quite sharp undulations, with many gradients between 1 : 111 and 1 : 143. Then the line descends to the neck of the Cotentin peninsula at Lison, and for 25 miles the track is more or less level. Beyond Montebourg, however, it is necessary to cross the east-west slate ridge which forms the head of the peninsula, and this is effected by a steep rise at 1 : 116 followed by a steeper descent (6 miles at 1 : 100) which brings the line right to Cherbourg. This last bank is of course a very tough proposition for heavy Paris-bound trains.

### (iii) *Paris-Havre* (Fig. 97)

#### *Summary*

- (1) Length: 228 km. (142 miles).
- (2) Track: Double track throughout with exception of Paris suburban and Rouen areas.
- (3) Maximum permissible axle-load: 16 tons.
- (4) Gradients: Maximum gradient against west-bound trains, 1 : 181; maximum gradient against east-bound trains, 1 : 125.



- (5) Traction: Steam.
- (6) Maximum distance between stations: 11 km.
- (7) Marshalling yards (see Fig. 98): Achères, Mantes-Gassicourt, Rouen (Sotteville), Havre (Soquence).
- (8) Engine sheds (see Fig. 98): Batignolles, Achères, Mantes-Gassicourt, Sotteville, Rouen, Havre.

For 86 miles to Rouen this line follows the Seine valley; there is no gradient steeper than 1 : 200 and there are long stretches almost or quite level. The river itself is crossed three times in the first 10 miles, before the junction of Achères, but then the line remains on the south side of the valley, through Mantes and Vernon, occasionally rising and falling slightly where it cuts across the core of the several large northward-sweeping meanders, until within 15 miles of Rouen, when the great Elbeuf meander makes it necessary to cross the river three times more in order to secure a fairly direct entry into the city. From Rouen to Havre the line takes a course over the loam-covered chalk plateau of the 'Pays de Caux' rather than attempting either to follow or to cut across the huge meanders of the Seine; the last 6 miles of the ascent to Motteville are at 1 : 181, and then after 25 miles of more gentle undulations a steep 6-mile descent at 1 : 125 to Honfleur brings the line down to the Seine estuary within 4 miles of Havre.

### *Axle-loads*

The whole of the western region lines were equipped for an axle-load of 16 tons. This is the only region of the French railway system in which no greater load than 16 tons per axle was permissible; thus no part of the western region appears on Fig. 70. It should be borne in mind that axle-load is not merely a function of rail weight, but also of the nature of the infrastructure, i.e. ballast and particularly bridge strengths.

### *Electrified Lines*

The year of the great Paris Exhibition, 1900, is a landmark in French railway history, for it was that year that the first electric railways began to operate. Both the first two lines were in the Paris area; one was the Métropolitain (see p. 324), and the other was the Invalides-Versailles (R.G.) line of the Ouest railway. The Etat followed soon after with the conversion of several sections of its Paris suburban lines, out of St Lazare, to electric traction, and some 103 km. of line, carrying a traffic comparable in density with that of the Southern Railway in the London suburbs, were ultimately dealt

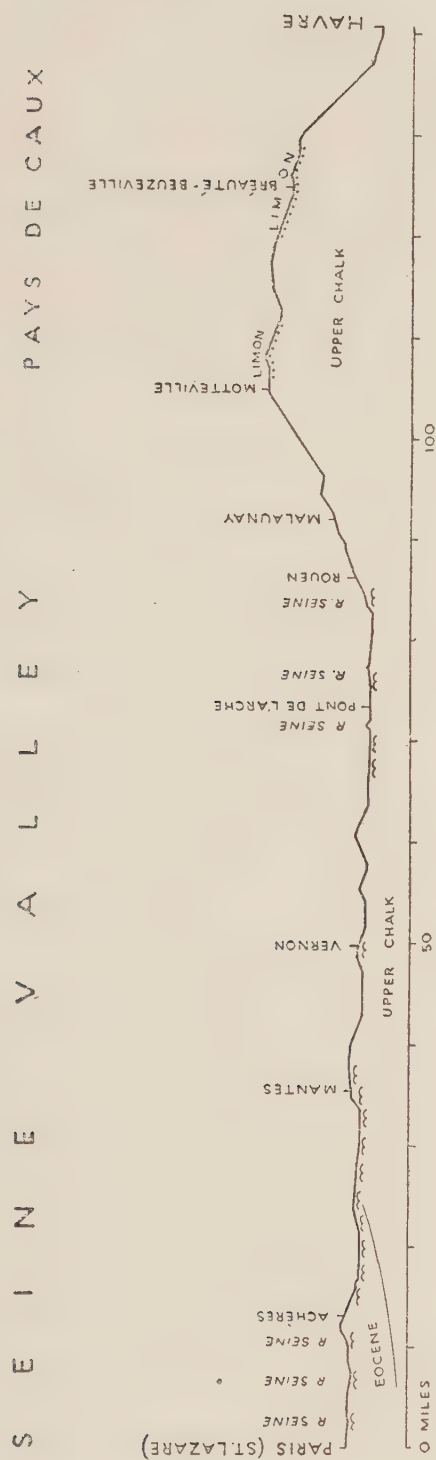


Fig. 97. Gradient profile, Paris-Havre



with. The suburban lines concerned are as follows (see Fig. 69): (i) Invalides-Versailles (R.G.) (18 km.), (ii) St Lazare to Auteuil (on the Petite Ceinture line), Argenteuil (10 km.), St Germain-en-Laye (21 km.), St Nom-la-Bretèche (30 km.), Versailles (R.D.) (23 km.) and Issy-Plaine (20 km.). These lines are operated by current at 650 V. d.c. picked up from a third rail. Current is derived from four thermal-electric power stations on the banks of the Seine, and through them is also available from the hydro-electric sources in the Central Massif. The station at Moulinaux was actually owned by the Etat railway, the other three, Nanterre, Issy and Gennevilliers, belonged to the Union d'Électricité. The passenger traffic is operated by multiple-unit trains.

More recently a beginning was made with the projected electrification of some of the main lines, and the Paris (Montparnasse)-Le Mans section of the main Brest line commenced operating by electric traction in 1937. The same technique as for the P.O.-Midi lines was adopted, viz. 1,500 V. d.c. derived from overhead wires. The current is derived ultimately from the hydro-electric stations of the Central Massif, supplemented by the Paris thermal-electric plants, but the key transformer stations which feed the line are at Elancourt (near Versailles) at the Paris end of the line, at Luisant for the middle (Chartres) portion and at Arnage for the Le Mans end (Plates 67, 68).

### *Passenger Traffic*

Passenger traffic on the Etat lines in 1936 totalled 176 millions. No figures are available giving the exact proportion of this huge total represented by the Paris suburban traffic, but the fact that the St Lazare terminus alone handled 300,000 passengers a day suggests that between one-half and two-thirds of the total may well be accounted for by the daily movement to and from the suburbs. Other figures indicate the vital difference in the character of the passenger traffic from that of any of the other lines. The average length of journey per passenger was shorter—at 28·8 km.—on the Etat railway than on any of the others except the A.L. line (which had less than one-quarter of the mileage of line); moreover, the figures for the different classes are a complete reversal of similar figures for the other lines—first class journeys averaged only 17·4 km. in length, second class 15·9 km., and third class 38·3 km. First and second class suburban season ticket-holders are responsible for this, and it should be borne in mind also that some of the suburban services have no third class accommodation at all.

The passenger traffic of the region falls into four main classes: (i) Paris suburban, (ii) international, (iii) holiday, (iv) general.

(i) The intensive Paris suburban traffic is worked partly by electric trains, partly by 'push and pull' steam trains (which work with the engine always at the Paris end—see Plate 71) with the outer suburban or 'grande banlieue' services worked by ordinary steam trains. The electric services from St Lazare extend to Auteuil, Argenteuil, St Germain-en-Laye, St Nom-la-Bretèche, Versailles (R.D.) and Issy-Plaine, and the outer suburban steam services as far as Pontoise (30 km.) and Mantes (58 km.). From Invalides electric trains run to Versailles (R.G.), and from Montparnasse the inner suburban electric service runs to Versailles (Chantiers), the outer suburban to Chartres (88 km.) (electric) and Dreux (82 km.) (steam). In addition, the 71 km. section of the Grande Ceinture line from Juvisy via Versailles (Chantiers) to Argenteuil is operated as part of the western region.

(ii) International traffic is not nearly so great as on the lines of the northern region, for the ports served are not the popular 'short-sea-passage' ones such as Calais and Boulogne. Dieppe, with its peacetime twice-daily service from Paris to London via Newhaven, was the nearest approach to these. Havre and St Malo had daily services to Southampton, whilst Cherbourg dealt with transatlantic traffic.

(iii) The western region includes a large part of the French coast-line, on which lie many of the most popular seaside resorts. On the edge of the Pays de Caux, St Valéry, Fécamp, Etretat and others are served from Dieppe or Havre or from branch lines; Trouville-Deauville is on a branch of the Cherbourg line; Granville has a main line all to itself; St Malo and Dinard are on branches from the Brest line; many tiny resorts round the Brittany coast are served from the Brest or Quimper lines; farther south the chief watering-places are Les Sables d'Olonne and Royan, both on branches from the Paris-Bordeaux line.

(iv) The general traffic over the rest of the region is light, and there has been considerable substitution of rail services by road vehicles (see p. 319 and Fig. 99).

### *Freight Traffic*

The freight traffic of the western region—which amounted in 1936 to just under 30 million tons, the lowest of all the systems except the P.O.-Midi—would be very small indeed but for two major geographical facts, for the territory served is almost completely agri-



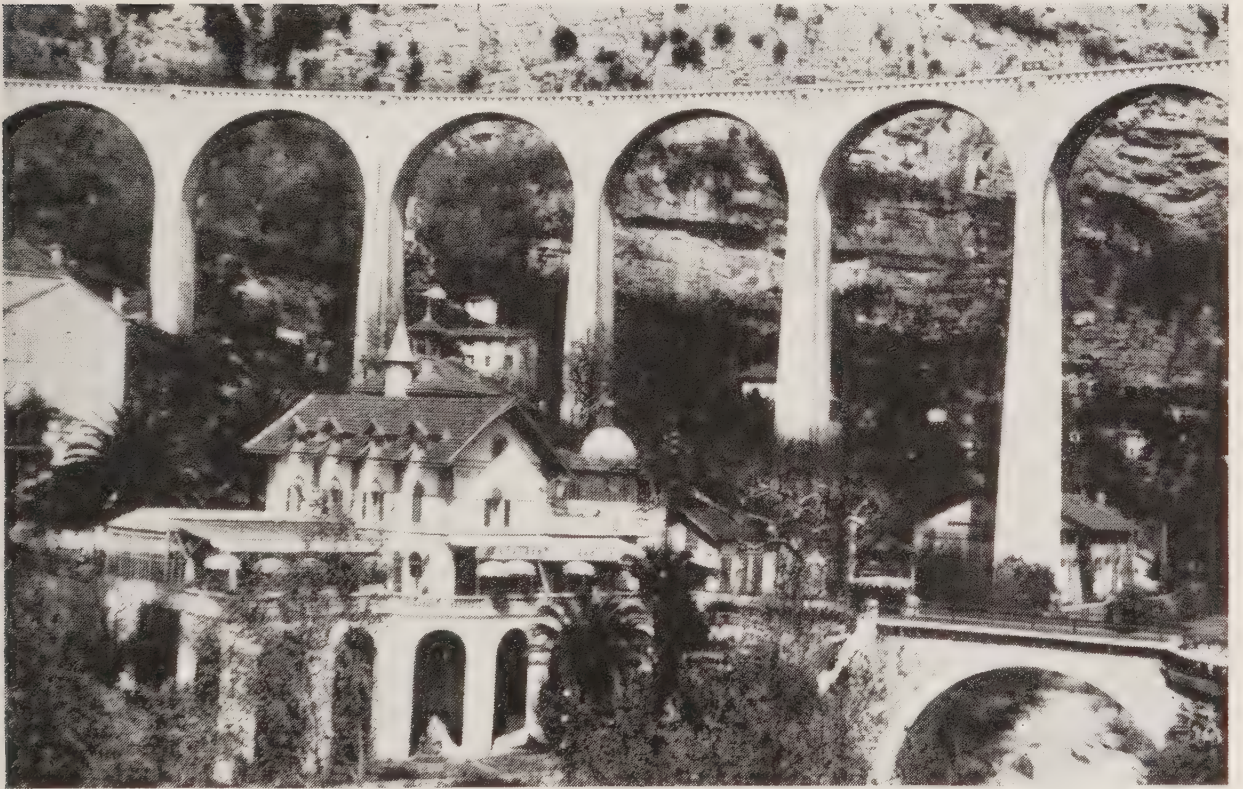
cultural and rural. The two facts are the existence of the vast urban market of Paris and of a series of ports on the coast of Normandy and Brittany. The former Etat railway played an important part in the provisioning of the capital city and in supplying with fuel the scattered towns and villages.

As usual, the most important item by weight is coal—over 5·3 million tons in 1936. The most important French coal-importing port is Rouen, but by far the greater part of its tonnage reaches the Paris area by water and the railway plays but a small part. Other ports, however, such as Dieppe, Havre, St Malo, Brest, St Nazaire, La Rochelle and particularly Nantes, also import coal, mainly from Britain, and send it inland by rail. Large quantities of coal also enter the western region from the northern coalfield; the wagons are sorted for distribution in the marshalling yards at Rouen and on the outskirts of Paris at Achères and Trappes. Much of the coal carried by rail is actually for locomotive use—the depots at Achères, Trappes, Caen and Rennes, for example, are all equipped for handling 500 tons of locomotive coal per day, and those at La Rochelle, Havre, Le Mans and Sotteville can deal with 250 tons per day.

The second item by weight is 'stones'. Road metal is available in great abundance in the old rocks of the Breton Massif, whilst granite for building purposes is also quarried at many places, notably around Vire, Louvigné and Combourg.

The agricultural character of the western region and the traffic in imported foodstuffs between the ports and Paris result in the carriage of a heavy tonnage of foodstuffs and of fertilizers. Cereals, flour and other foodstuffs together totalled over 3 million tons in 1936. Milk is a very important item, collected from a wide region within 200 miles of Paris; and almost four-fifths of the Paris consumption of butter is transported by rail from Charentes, Poitou and Normandy, where one single co-operative alone, the 'Laiteries des Charentes et Poitou', had 138 factories with an output of 21,000 tons of butter per annum. Vegetables and some varieties of fruit (e.g. strawberries from Plougastel near Landerneau) travel eastwards from Brittany, and upwards of 100,000 tons, mainly of potatoes and cauliflowers, reach Paris from this area. There is also the specialized banana traffic, carried in insulated vans, and frequently in special train-loads. Ports served by the Etat railway handled on an average just over one-half of all the French banana import. Lastly, in Dieppe the western region has a fishing port of considerable importance, and a highly organized service of insulated refrigerator vans operated daily between the port

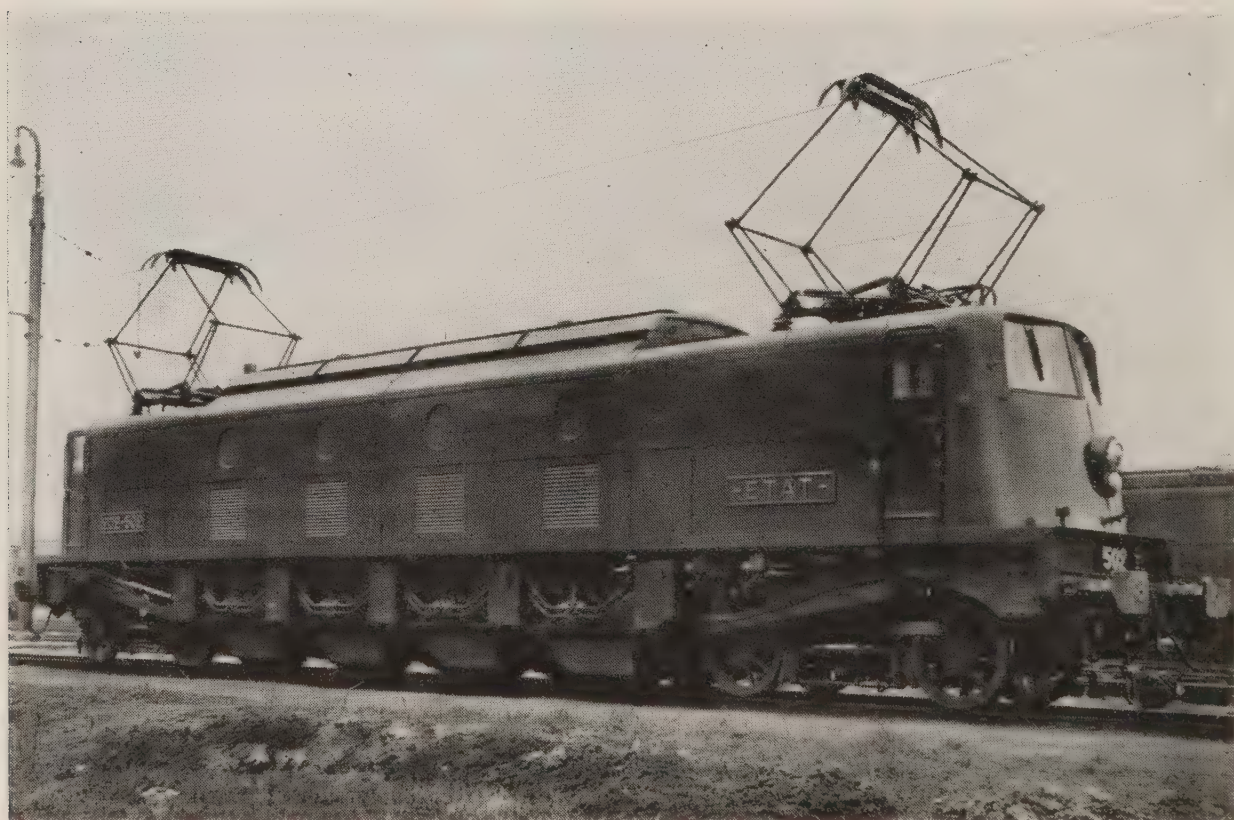




Plates 65, 66. Viaducts

Much of France is relatively easy country for the railway builder, but there are many areas where mountainous terrain or the deep dissection of the land surface render large viaducts necessary. Plate 65 (above) shows the Morlaix viaduct in northern Brittany, 292 m. long and 63 m. high, on the main Paris-Brest line. Plate 66 (below) shows the Gorges du Loup viaduct, near Grasse, in the Alpes Maritimes, which carries the narrow gauge Provence railway (see p. 317).





Plates 67, 68. The electrified line, Paris-Le Mans

Plate 67 (above) shows a section of the track, with overhead wire equipment. Plate 68 (below) shows a 2-Do-2 electric locomotive for use on the line; the engine is capable of hauling a 700-ton train at 80 miles per hour along a level track. The pantographs for collecting current from the overhead wires are clearly shown. Note: this line belonged to the Etat railway before the formation of the S.N.C.F.

and many different parts of France, about one-third of the traffic going to Paris (Batignolles).

The western region has also a considerable animal traffic, over 1·6 million head in 1936. This is not due to transhumance, however, as in the south-eastern and south-western regions, but results from the considerable movement of fat cattle and sheep from Normandy and the western part of the Paris basin generally to the Paris abattoirs.

### *Sheds, Works, Marshalling Yards*

The location of all locomotive sheds except very small ones is indicated on Fig. 98 (on which, however, less important lines are omitted); the larger sheds are indicated by larger symbols. Here, as in the south-western region, fifty engines may be taken as a very rough dividing line between the larger and less important sheds. The sheds accommodating the electric locomotives on the Paris-Le Mans line are specially distinguished.

The chief locomotive works are at Paris (Batignolles), Rouen (Sotteville), Rennes and Saintes. Rennes is also the main centre for rail-car repairs. Carriage and wagon repairs are concentrated at Le Mans, Rennes, Sotteville, Mantes, Paris (Montrouge) and Nantes (Blottereau); the main repair depot for electric stock is La Garenne, in the suburbs of Paris.

The more important marshalling yards and concentration sidings are also indicated on Fig. 98. The largest yards, with hump shunting, are at Rennes (capacity 4,000 wagons per day), Sotteville (capacity 7,000–8,000 per day), Le Mans, Trappes (capacity 3,000–4,000 per day), and Achères.

## SECONDARY LINES

Included in the total of 'intérêt général' lines in the table on p. 248 are 1,687 km. of 'secondary lines' which did not form integral parts of the great railway systems and yet were not part of the 'intérêt local' network. A few notes are appended on the most important of these lines.

*Somain-Anzin.* This standard-gauge and mainly double-track line, 37 km. in length, runs from Somain via Denain and Anzin to the Belgian frontier at Peruwelz. It is by far the most important of the secondary lines, for serving a part of the northern coalfield it has a considerable traffic, which in 1936 amounted to 1·8 million passengers and 7·8 million tons of freight (mostly coal).



*Chemins de Fer Économiques.* This small system of narrow-gauge lines, totalling 174 km. of single-track lines, serves an almost entirely rural area of Picardy, centring upon Albert. Passenger traffic, served very largely by rail cars, totalled 151,000 in 1936, and freight traffic 72,000 tons (of which 22,000 coal).

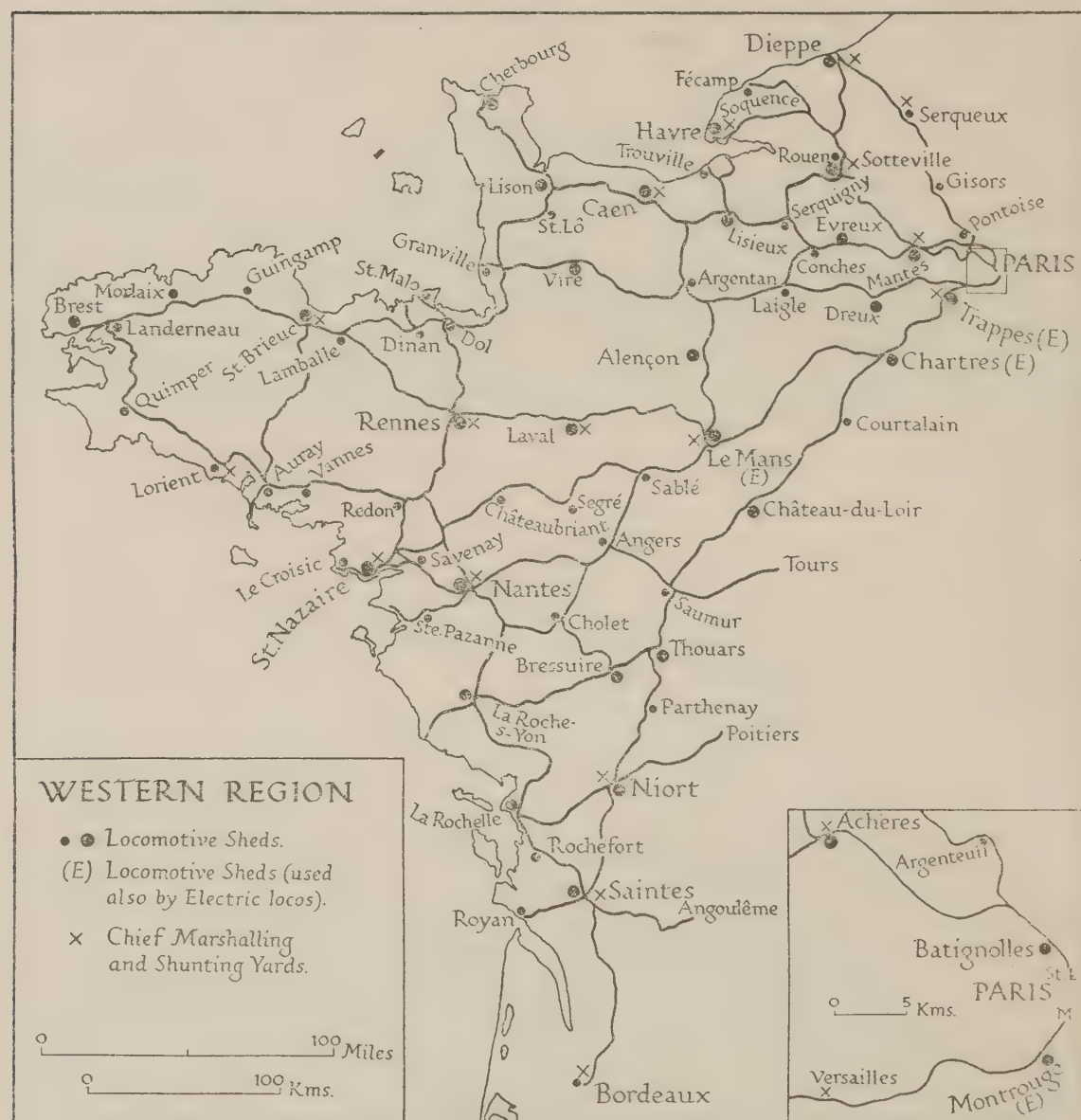


Fig. 98. The main lines of the *Région Ouest*

Showing the location of the chief locomotive sheds and marshalling yards.

*Chemins de Fer Départementaux.* This organization comprised two quite distinct systems of narrow-gauge, single-track lines. The first, the Charentes lines, with 229 km. of track, serves an area centring upon Angoulême (and thus now divided between the western and south-western regions of the S.N.C.F.); in 1936 it carried 351,000 passengers and 60,000 tons of freight (in which 'stones' and coal were

the chief items). The second, the Vivarais section, consists of several lines totalling 252 km., in the eastern part of the Central Massif, which in 1936 carried 541,000 passengers and 105,000 tons of freight (mainly coal, 'stones' and timber, with some 13,000 animals—cf. the 'transhumance' traffic of the P.L.M.).

*Chemins de Fer de la Provence.* Linking Nice with the Marseilles-Grenoble line, via Digne and via Draguignan, this system comprises 349 km. of single-track, narrow-gauge lines (Plate 66). Its traffic in 1936 consisted of 206,000 passengers and 55,000 tons of freight. The chief item in the freight traffic was 'ores', no doubt almost entirely bauxite destined either for the Plan du Var smelter or in transit to the P.L.M. line (for the Grenoble region).

*St Georges-de-Comiers-La Mure.* This was the only portion of the 'Société Grenobloise de Tramways Électriques' to be included in the 'intérêt général' system. An electrified line, 67 km. in length, running from St Georges-de-Comiers via La Mure to Corps and Valbonnais, it serves the La Mure anthracite field and power stations in the Drac valley south of Grenoble. Its passenger traffic in 1936 was 281,000, its freight traffic 343,000 tons, including 312,000 tons of coal. The electrical equipment of the railway consists of a third rail which feeds current at 2,400 V. d.c.

#### RAILCAR AND RAILWAY-OPERATED ROAD SERVICES

The competition of the road as a means of both passenger and freight transport, referred to on p. 246, is of course a phenomenon familiar enough in all countries within the last two decades, but it reached an acute stage in France during the 'thirties. Apart from the normal reasons for the increasing severity of road competition, e.g. greater efficiency of frequent small-capacity road services than of infrequent, large-capacity trains, decreasing costs of oil as opposed to coal, etc., the road vehicle in France held a considerable advantage over the railway train because the roads do actually enter the towns and villages and so provide door-to-door transport, whereas the railway frequently does not. In general the railways in rural areas steer a course between villages, and stations are often far removed from centres of population. Thus of something like 15,000 railway stations in France, over 2,000 have double-barrelled names referring to two villages more or less equidistant from the station, e.g. Amagne-Lucquy, Les Laumes-Alésia, Culmont-Chalindrey.

The reply of the railways to the competition of road vehicles



took two forms: (a) the employment of railcars ('autorails', mainly propelled by engines using petroleum or heavy oil, with some Diesel-electric), by which a more frequent service with a seating capacity approximate to that of a large road vehicle could be economically maintained (Plate 70); (b) the complete substitution by their own road vehicles of rail-passenger services on many lines in rural areas.

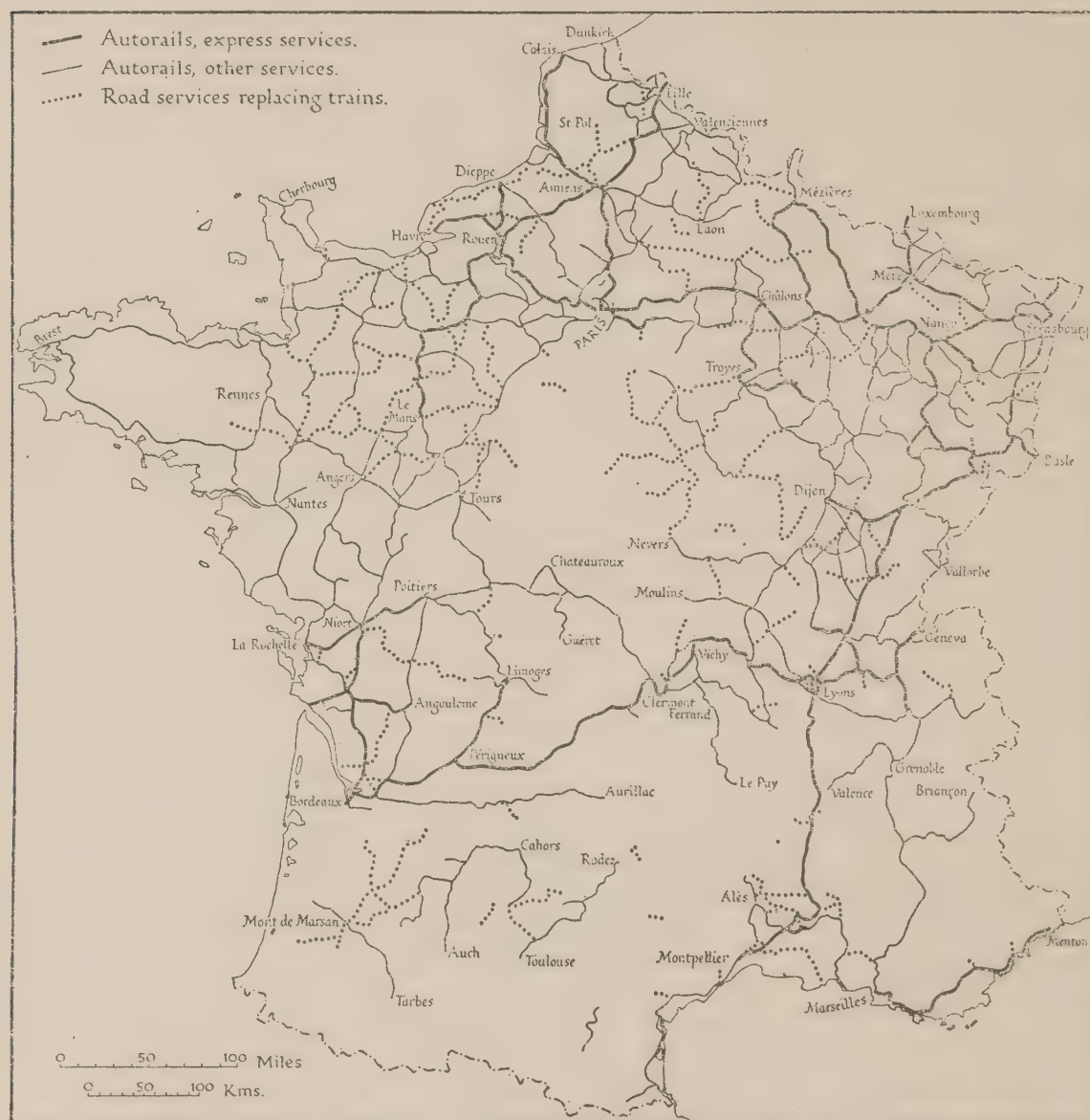


Fig. 99. Railcar and road services on the S.N.C.F. in 1939

Based on data contained in the *Indicateur Chaux*.

The extent of the development of these two forms of transport in 1939 is indicated in Fig. 99.

A number of features of geographical significance are observable on the map:

(1) In the northern and eastern regions, some express railcar services were used to supplement steam expresses. Elsewhere, express

railcars were mainly employed to provide fast services on cross-country lines or on lines which were not well served by steam expresses. Thus the difficult Bordeaux-Clermont-Ferrand route, which between Brive and Clermont is almost a mountain railway, reaching an altitude of over 3,000 ft. and with gradients of 1 : 40, was worked by Renault Diesel-electric cars. In the south-eastern region the main Paris-Marseilles line was too congested with heavy long-distance expresses and freight trains to warrant the use of fast railcars, and the service between Lyons and Nîmes travelled via the right bank of the Rhône. In the south-western region the use of electric traction, with resultant economies in the working of a more frequent service of short trains, prevented the employment of express railcars, and in the western region the traffic hardly warranted their use.

(2) The use of 'petite vitesse' railcars was widespread, mainly on lines other than those carrying the main traffic streams. Again, the electrified lines of the south-western region cause large blank spaces on the map. The almost complete absence of railcars from the Lorraine industrial district is interesting; no doubt it reflects the nature of the passenger traffic, which consists mainly of movements of workmen in large numbers at certain hours of the day—traffic far better accommodated by long trains of third class coaches with wooden seats than by richly upholstered railcars of small capacity.

(3) The distribution of bus-substituted lines is striking. In part it is a reflexion of the density of the rail network in rural areas; in areas where the mileage per head of population was greatest there has been most substitution of steam trains by road vehicles. The main areas are Normandy and the south-eastern part of the Paris basin, the two regions separated by territory served by the P.O. electrified lines.

It should be borne in mind that in almost all cases goods traffic continues to be rail hauled; very few, if indeed any, of the lines have been completely abandoned.

The map relates to 1939, but the following figures for 1936 give an idea of the extent to which railway operation of road services had developed at that time, and suggests that considerable developments took place between 1936 and 1939, especially, for example, on the Etat (western region). The tourist services (in the Alps, Pyrenees, Central Massif and Vosges) represent a great length of route but a very small number of passengers. The column headed 'Others' consists chiefly of services run by the railways to act as feeders.



Railway	Length of road services (km.)			Passengers (ooo's)		
	Replacing or supplementing trains (A)	Tourist routes (B)	Others (C)	A	B	C
Etat	193	—	—	262	—	—
A.L.	156	1,365	—	870	7	—
Nord	—	—	1,758	—	—	1,394
Est	480	1,007	615	1,034	14	204
P.O.	233	6,632	3,326	169	14	669
Midi	—	515	1,145	—	2	236
P.L.M.	1,300	21,463	2,301	2,659	302	1,456

### RAILWAYS IN THE PARIS AREA

Rail transport of both passengers and freight forms an integral part of the economic life of any modern town, and in the case of great cities it may be described as a vital element without which the daily life of the community would be quite impossible. The functions of the railway in such an environment are manifold. For passenger traffic, the railway system of a great capital city must provide (a) adequate means for transporting the suburban-dwelling workers to and from the city daily, and very largely at two specific 'rush-hour' periods, thus necessitating spacious terminals and multiple tracks; (b) main-line services to the principal provincial centres. From this point of view, therefore, the railway plan should consist of a series of lines radiating from the city, with perhaps a series of tentacles or branches on the outskirts serving suburbs. Interterminal transport facilities will also be desirable; such facilities may take the form of a surface railway actually connected with the terminals, or an underground line without such physical connexion.

As regards freight traffic, the railways must provide, in the first place, for the daily food supply of the vast population. This necessitates the provision of adequate unloading, transshipment and perhaps also marketing facilities at the terminals, preferably not too close to the passenger terminals lest congestion ensue. The capital city, moreover, simply by reason of its position at the focus of a series of radiating railway lines, is almost bound to act as an entrepôt for goods from one part of the country or from abroad destined for another part or another country. It will be more convenient, and probably quicker, to send a small consignment of goods via the entrepôt, where sorting facilities will exist and where the small consignment will become part of a larger consignment for the same destination, than

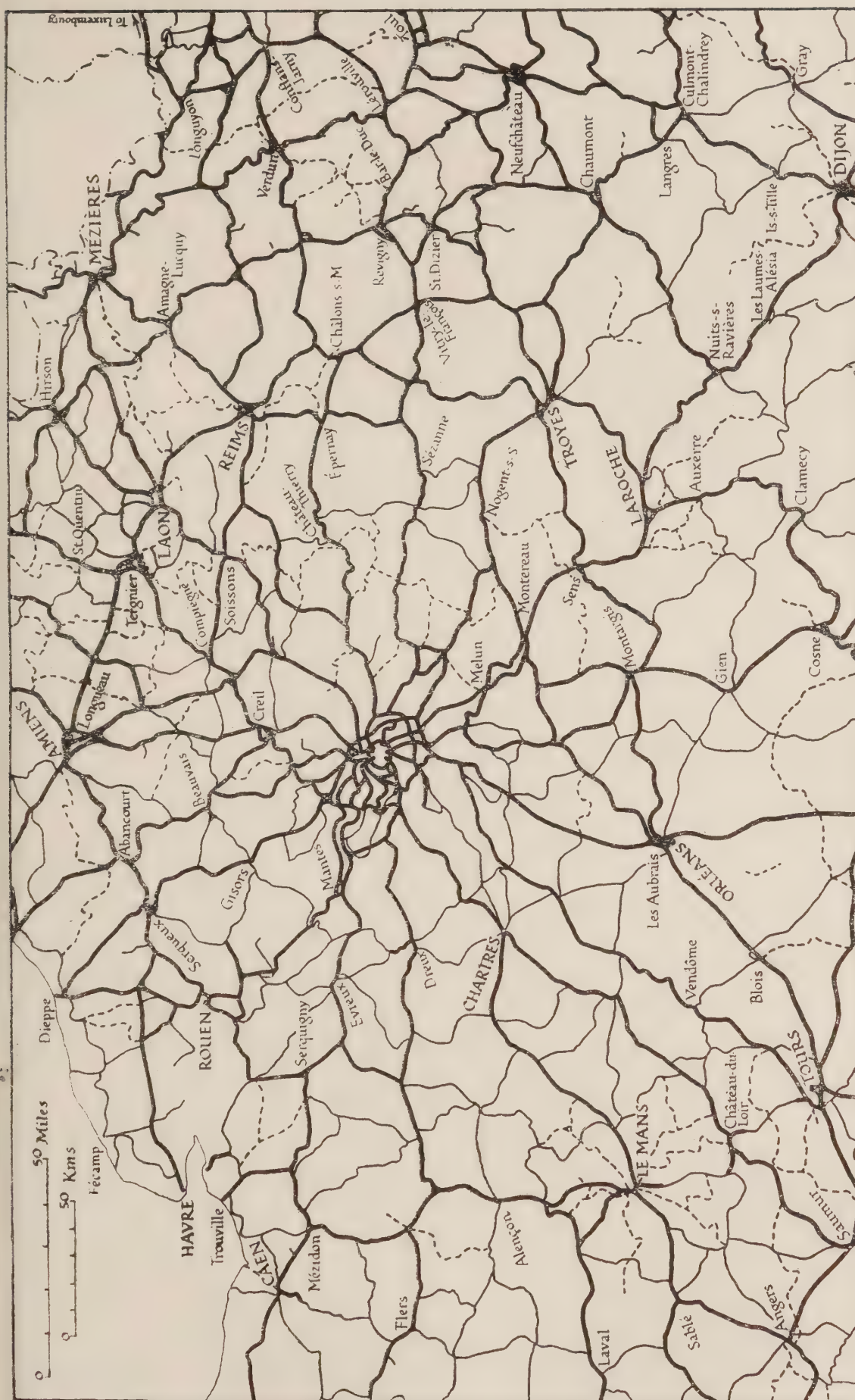


Fig. 100. Railways in the Paris basin. For key see Fig. 94.





via a somewhat circuitous cross-country route. The main need of the city, therefore, will be (i) sorting facilities, where traffics from all directions can be reassembled for their destinations, and (ii) adequate connexion from one radial main line to another. Thus the belt or girdle line becomes an almost inevitable feature of the railway pattern, and, since the sorting of railway wagons necessitates much open space, the great sorting and marshalling sidings tend to spring up on the outskirts of the city, most probably at or near the places where the belt line crosses the radials.

The ideal railway plan for a large city thus somewhat resembles a wheel: the city is the hub, the main lines are the spokes, and the circumference is the belt line. Naturally the symmetry of this arrangement will depend on numerous factors connected mainly with the history of the growth of the lines, with the nature and source of the traffics, and with physical circumstances.

The railway network of the Paris region fits in more perfectly with this ideal scheme than that of any other city in the whole world (see Fig. 101).

The following are the chief elements in the plan:

(i) *Radial main lines and terminal goods stations*

Proceeding clockwise from the northern side of the city, the following may be noted: Nord station, with goods station at La Chapelle; Est, with La Villette; Bastille, with Reuilly; Lyon, with the two large goods stations at Bercy, one inside and the other outside the city wall; Quai d'Orsay, connected underground with Austerlitz which is also a passenger terminal, with goods stations at Austerlitz and Ivry; Luxembourg (terminus of the former P.O., now Métropolitain outer suburban line to Sceaux) (no goods station); Montparnasse, with goods station at Vaugirard, Invalides (terminus of the electric line to

Fig. 101. The rail network of the Paris region

The map shows the location of locomotive sheds, goods stations and marshalling yards, and of certain elements in the food and power supplies of the city. Owing to the congestion of symbols (all of which are accurately placed in relation to the railway lines), no attempt has been made to distinguish the relative importance of the sheds and yards; reference should be made to the foregoing text and to Figs. 76, 82, 86, 93, 98. See also vol. III, chapters II and V of this Handbook. Key to abbreviations: *Stations*: *St L*, St Lazare; *N*, Nord; *E*, Est; *B*, Bastille; *L*, Lyon; *A*, Austerlitz; *O*, Quai d'Orsay; *L*, Luxembourg; *M*, Montparnasse; *I*, Invalides; *Others*: *P.C.* Petite Ceinture; *G.C.* Grande Ceinture; *L.C.* La Chapelle; *L.V.* La Villette; *Vd*, Vaugirard. The un-named spot south of Vaugirard is Montrouge loco. shed, which replaced an old one at Vaugirard (see also Fig. 98).



Versailles R.G.) with Javel; and lastly St Lazare with the large goods depot at Batignolles. Bercy, reception point of the 'primeurs' traffic, and Batignolles, which receives foodstuffs from the west, are probably the most important of the goods stations.

The relation of 'Les Halles', the central markets, to the terminal goods stations is indicated on Fig. 101. The markets are almost exactly equidistant by about 4 km. from each of the goods stations; as a result a considerable amount of lorry traffic takes place especially during the night, to cover this gap between the rail head and the market.

## (ii) *Interterminal rail facilities*

(a) *Petite Ceinture*. The inner girdle line, or Petite Ceinture, which runs round the city boundary on the inner side of the old fortifications, came into being as a result of a decree passed a week after the *coup d'état* of 1848 (cf. p. 239), and it cannot be maintained that its purpose was to facilitate interterminal passenger traffic. By means of connecting spurs, however, it became linked with almost all of the nine radial lines, and eventually performed two functions, one being to carry passengers from one part of the inner suburbs to another, and the other to give passage to through trains crossing Paris from one main radial line to another, and especially from the Gare du Nord to the Gare de Lyon. In 1880 the Petite Ceinture carried 16 million passengers; in 1908 the figure had risen to 27½ millions. Thereafter, however, the internal combustion engine, as applied to omnibuses, taxis and private cars, began to reduce the traffic considerably, and by 1933 the number of passengers had fallen to 7 millions. In 1934 local passenger traffic ceased, being largely replaced by omnibuses; but the western region operates an electric shuttle service between Pont Cardinet and Auteuil-Boulogne (serving the famous Bois de Boulogne and the Auteuil racecourse), and certain Channel-Mediterranean through trains pass over the line from the northern to the south-eastern region or vice versa. In 1936, 125,000 passengers travelled on the line, of whom two-thirds were second class and only 11% third class. Freight traffic continues to pass over the line, and in 1936 the total tonnage approached 3 millions.

(b) *Métropolitain*. Although the first plans for local city railway lines date back to 1871, it was the preparations for the 1900 Exhibition which rekindled the idea in the late 'nineties. An underground course was obviously necessary and electric traction was therefore natural.

The city authorities undertook to drive the tunnels, letting to an



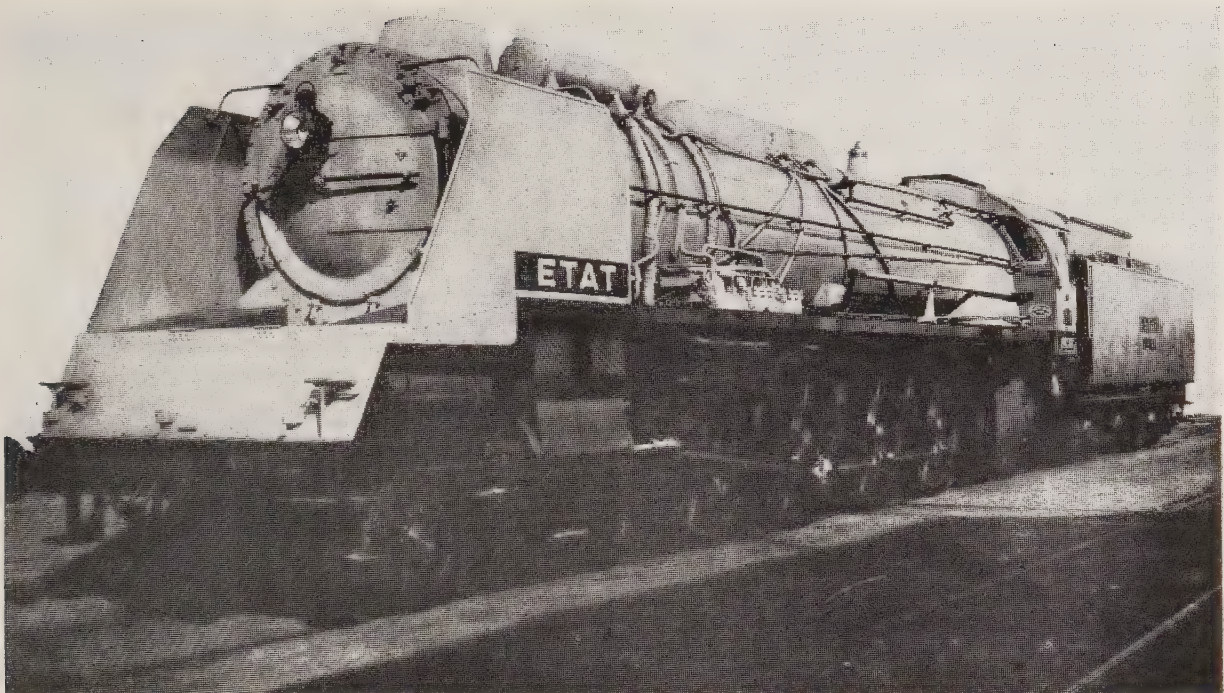


Plate 69. An Etat 'Mountain' (4-8-2)

A powerful express engine specially designed for the haulage of transatlantic boat trains between Paris and Cherbourg, built by the Fives-Lille works in 1933. (See p. 309.)



Plate 70. A stream-lined railcar

This Bugatti *automotrice*, seating fifty-two passengers and developing a speed of 100 m.p.h., is representative of a type of rail transport which has become increasingly popular on the French railways during the last decade. (See p. 319 and Fig. 99.)





Plate 71. Suburban train near St Lazare station, Paris

These trains, composed of nine double-deck coaches, are specially designed to give a very high carrying capacity and the minimum of delay at terminals. The engine, a powerful 2-8-2 tank locomotive, is always at the Paris end; it pushes its train out to the suburbs, and pulls it back again.



Plate 72. The Paris Métro

The view shows a train on line No. 5 emerging from underground in order to cross the Seine by the Austerlitz viaduct (see Fig. 102). The Métro trains are also designed to accommodate as many passengers as possible: there are few seats, but plenty of standing room.



entrepreneur the task of providing the permanent way, rolling stock and electric current, and of operating the line. The entrepreneurs were the 'Société Générale de Traction' (associated with Le Creusot engineers), and in 1898 they formed the 'Cie du Métropolitain de Paris', with 25 million francs capital, to equip and operate six lines, totalling 65 km. length, with standard-gauge track but with a loading gauge slightly smaller than that of the main-line railways (for most of the lines were to be underground).

The first line, from the Porte Maillot across the heart of the city (via Etoile, Concorde, Palais Royal and Bastille) to the Porte Vincennes, was opened in 1900, and others followed. The city levied a tax on each ticket sold, to repay the cost of the works. A second undertaking—the Nord-Sud railway—was a purely private undertaking established in 1901; its first line, from the Porte de Versailles to St Lazare, was opened in 1910.

Some important developments have taken place during the last 12 years. In 1930 the Métro was the most intensively worked urban electric line in the world, its 7·6 million passengers per kilometre of line comparing with figures of 4·5 for the Berlin underground, 3·2 for that of London and 5·8 for that of New York. Yet its confinement within the former city walls hindered its usefulness, and the competition of the suburban electric tramways and the rapid increase of road traffic between the suburbs and the city were also features which it was desirable to overcome.

In 1930 the Métro absorbed the Nord-Sud, thus bringing the whole system, then totalling 125 km. of line, under a unified control. An extension was opened in 1931 from Palais Royal to the Porte d'Ivry, another from Opéra via Bastille to the Porte de Charenton (for the Colonial Exhibition in the Bois de Vincennes), and a third from Odéon to Jussieu. In 1932, as part of a plan for extending its influence beyond the city walls, the Métro took over the P.O. line from the Luxembourg terminus to Sceaux and Massy-Palaiseau, and commenced the reconstruction of the line for electric operation, at a cost of over 140 million francs; other elements in the same plan comprised the extension of certain existing Métro lines to distances of 10–15 km. beyond the walls.

The plan of the Métro network is shown in Fig. 102, which also indicates the extent of the overground sections. Over 90% of the mileage is underground (excluding the Sceaux line), running mostly at shallow depth beneath the city streets. The deepest sections lie beneath the hills of Montmartre and Chaumont; the rail level at the



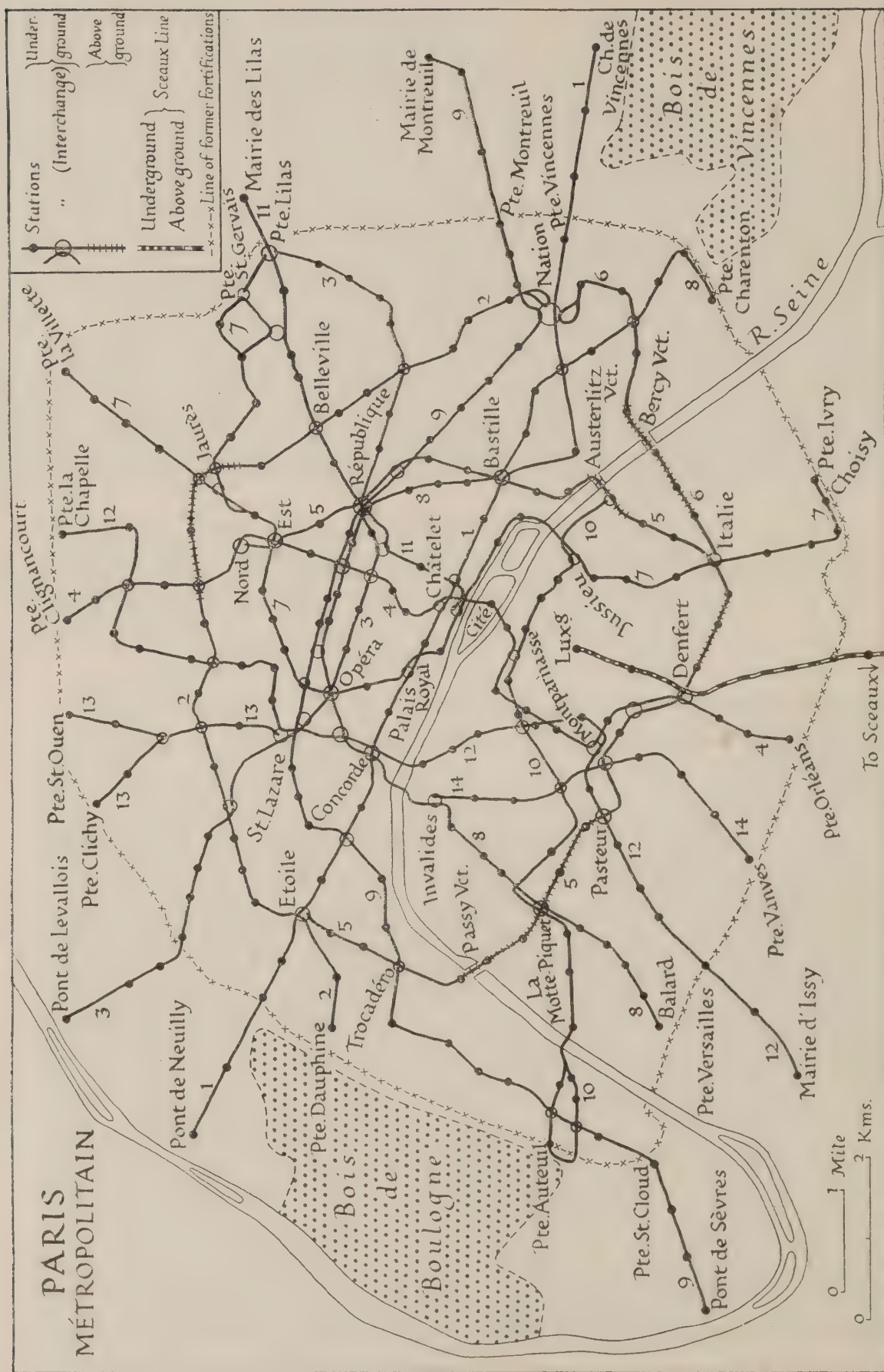


Fig. 102. The Paris Métro

The various routes are indicated by the numbers by which they are known. There are five tunnels under the Seine, and three viaducts over the river (see also Plate 72).

station of Buttes Chaumont is almost 100 ft. below ground surface. The Sceaux line was reopened in January 1938; in its first year it carried 18 million passengers compared with 8 million in 1937. New extensions of the urban lines brought the total mileage at the end of 1938 to 111 (178 km.). The chief interterminal links are lines nos. 4 and 5, the former linking Nord and Est with Montparnasse and Denfert, the latter linking Nord and Est with Bastille and Austerlitz. Other terminals can only be reached by changing from one Métro line to another, e.g. St Lazare to Lyon by changing at Concorde. It can scarcely be maintained that the Métro is as efficacious a means of interterminal transport as the London Inner Circle, for example.

The Métro trains are operated by current at 600 V. d.c., picked up from a third rail (Plate 72). The current is obtained at 10,000 V. a.c. from thermal electric power stations at St Denis and Ivry, and is transformed at twenty-nine substations scattered over the system. The Sceaux line has the standard P.O. type of equipment, i.e. 1,500 V. d.c. with overhead wires.

The chief repair works are at Choisy, on the south side of the city; there are others at Vaugirard, Italie, St Ouen, St Fargeau, Bobinage, La Croix-Nivert and Fontenay-sous-Bois.

### (iii) *Goods girdle line and marshalling yards*

The 'Grande Ceinture', or outer girdle, comprising 132 km. of double-track line, ceased to be a separate entity in 1935, and its administration syndicate was liquidated at the end of 1937 on the formation of the S.N.C.F., its operation being divided between the western and northern regions. The line varies in distance from the city centre between  $8\frac{1}{2}$  and  $22\frac{1}{2}$  km., being closest on the northern and north-eastern sides, farthest away on the southern side. Although passenger services are provided—in 1936 there were 1,361,000 passengers, of whom 97·6 % travelled third class—the main function of the line is to transfer freight between the main radial lines, and in consequence the chief marshalling yards are situated close to where it crosses these lines.

The section operated as part of the northern region commences at Argenteuil, where marshalling yards link the Ceinture with the western region lines to Pontoise and Mantes (via right bank of Seine). Proceeding eastwards the Ceinture crosses and is linked by spurs with the northern suburban lines to Pontoise and Beaumont, and then passes over the northern main line (to Amiens), swinging southwards to cross the second northern main line (to Laon) where it is linked to



the great marshalling yards of Le Bourget. It continues southwards to Bobigny, where there are more yards, and crosses the eastern region main line, where it is linked with the yards of Pantin and Noisy-le-Sec. Beyond Noisy-le-Sec, a further junction with the eastern main line gives access to the great modern hump yard (completed 1932) of Vaires. The line continues southwards, crossing the river Marne and passing underneath the eastern region Belfort line; it crosses the Verneuil suburban line at Sucy-Bonneuil and swings westwards to cross the former P.L.M. main line, with which contact is made in the marshalling yards of Villeneuve-St Georges. Running parallel to the P.L.M. Corbeil line, it crosses the Seine and links up with the main line of the south-western region (late P.O.) in the yards of Juvisy. Thenceforward the Ceinture forms part of the western region. Diverging from the P.O. line just beyond Juvisy, it strikes north-westward across rural terrain towards Versailles, via Massy-Palaiseau. Burrowing under the former Etat line to Chartres it makes contact therewith in the yards of Versailles Matelôts; these yards are now mainly used for storage, the marshalling activities having been transferred to the huge new hump yard (1931-2) at Trappes, a few miles farther down the main line. The Ceinture now turns northwards, passing the ends of the suburban electric lines at St Nom-la-Bretèche and St Germain-en-Laye, to Achères, where contact is made with the main Etat lines to Dieppe and Havre, in a recently enlarged hump yard (1935). It runs parallel to the Etat main line for a while, crossing the Seine at Maisons-Laffitte, and then diverges eastwards to Argenteuil.

Freight traffic on the Grande Ceinture in 1936 amounted to just over 12 million tons; no details are available as to the commodities comprised in this total. The locomotive stock of the Grande and Petite Ceintures combined in 1936 was 146; it included a number of small tank engines for light passenger trains, and a series of large articulated tank engines (0-6-2—2-6-0) for working heavy freight trains.

## THE VICHY REGIME

The military situation at the Armistice of June 1940 demanded, from the German standpoint, ample communications for three purposes: first for continuing the war directly against Britain, secondly for the possible conveyance of troops and material to Spain, and thirdly for meeting any emergency that might arise with Unoccupied France.

The first two purposes call for numerous routes from Germany to all ports and aerodromes on the north and west coasts, and the third indicates the need for efficient communications along the Armistice line dividing France and on the occupied side of it, while denying this facility to the Vichy government on the other side.

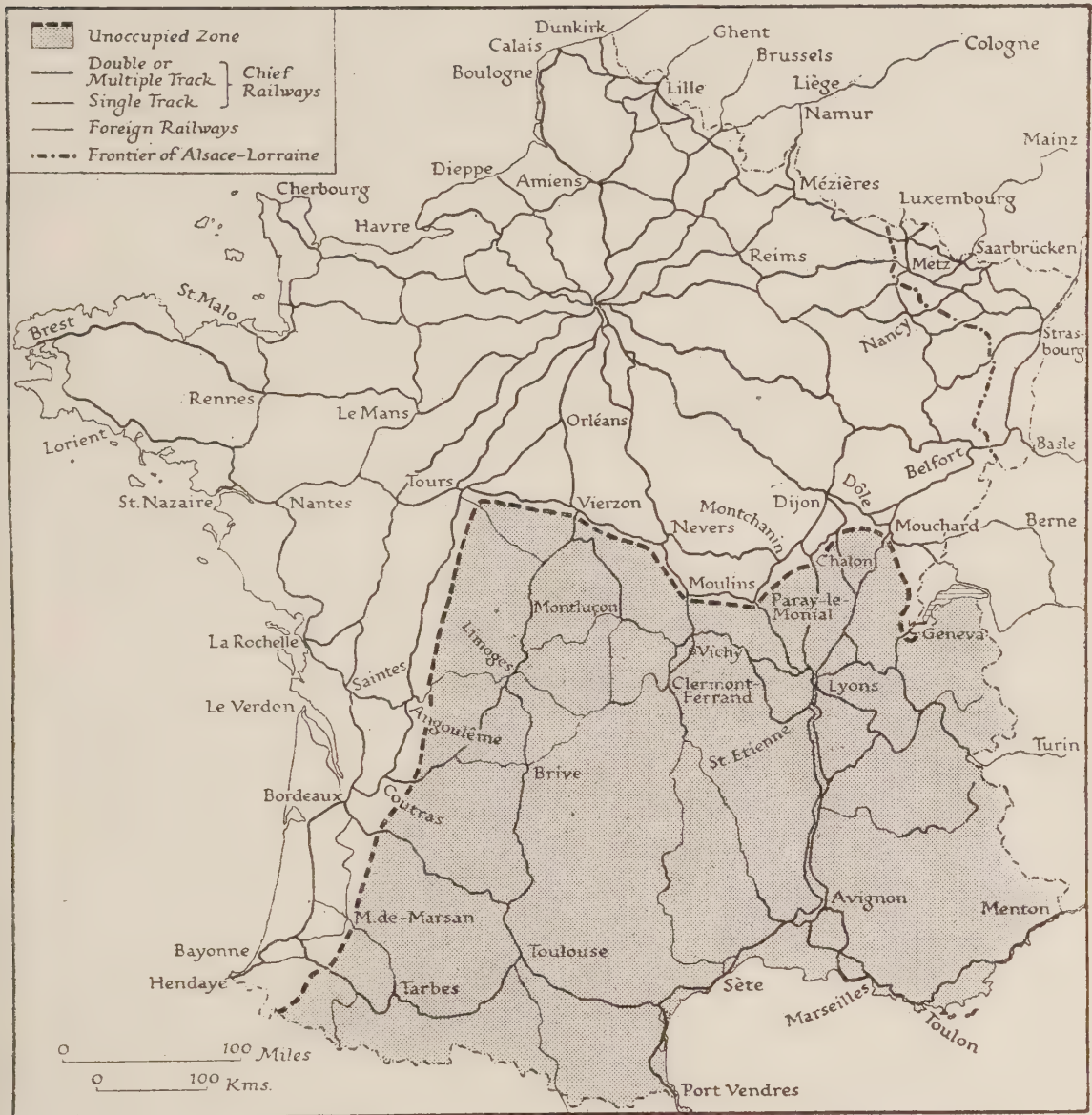


Fig. 103. Railways in relation to the Occupied and Unoccupied zones

Communication between Germany and the ports of the Channel and Biscay coasts is of course quite simple, since the whole of the lines of the eastern, northern and western regions of the S.N.C.F. lie within the Occupied zone. To the south-west, the main electrified line to the Spanish frontier is entirely under German control, for the boundary between the two zones has been drawn roughly parallel to this line, and some distance east of it, from near Tours to the



western Pyrenees. The important junctions of Poitiers, Angoulême, Coutras and Bordeaux are German-controlled, and in effect a duplicate line is available for almost the whole distance, though the former Etat line from Paris to Bordeaux via Saumur and Saintes is steam-operated, and the value of the secondary lines of the Midi system between Bordeaux, Mont de Marsan and Bayonne is probably small.

In north-central France the boundary line has been drawn parallel to and on the southern side of the important transverse main line between Tours and the Saône valley. Thus the great junctions, with their extensive marshalling yards and locomotive depots, of Vierzon, Bourges, Nevers, Saincaize, Moulins, Paray-le-Monial and Chalon-sur-Saône, are on the German side of the line, and there is no corresponding facility for east-west movement in the Unoccupied zone. Between the Saône valley and the Swiss frontier near Geneva the boundary line runs along the Doubs and across the Jura, thus leaving the main lines to Switzerland, from Dijon via Dôle to Vallorbe and Pontarlier, and from Bellegarde to Geneva, in German control.

Thus the Germans have complete control of movement along the whole Armistice frontier. Apart from the lines in the Rhône valley, most of the railways in Unoccupied France are difficult routes into or across the Central Massif, the Alps and the Pyrenees.

Despite the apparent severance of the country into two parts, the railway system has perhaps suffered less real disruption than many other elements of economic life. The S.N.C.F. is still in being, with its headquarters in Paris, and the five regional divisions are maintained. For the Unoccupied zone, however, a headquarters has been established at Limoges. Then, too, the railways of Alsace-Lorraine have been incorporated into the German railway system, the frontier of 1871-1919 having been restored. The Alsatian lines are administered as part of the Reichsbahndirektion Karlsruhe, whilst those of Lorraine, including Luxembourg, form part of the Rbd. Saarbrücken. Finally, in the south-eastern corner of the country, the slight Italian incursion along the Riviera has meant the westward shifting of the frontier station from Ventimiglia to Menton.

The military decision in the spring of 1940 was so swift that no such widespread destruction occurred as that which characterized the war of 1914-18. Comparatively little damage other than bridge destruction was sustained, and of 537 structures which were damaged—about half of them in the Région Est—nearly 400 were temporarily or permanently repaired by the end of the year, and by the spring

of 1942 rail communications had been fully restored everywhere except in a few places where the Germans apparently deemed it inexpedient to effect the necessary repairs, e.g. on the Vallorbe line across the Swiss frontier.

The maintenance of rail traffic in the whole of France, and especially in the Unoccupied zone, has been considerably hampered by several factors, one of the chief being lack of adequate rolling stock. The whole of the rolling stock of the eastern, northern and western regions fell into German hands, and a substantial proportion of that of the south-western and south-eastern regions as well, for many of the largest depots and traffic centres in these two regions lie in the Occupied zone. Moreover, there has been considerable requisitioning of French rolling stock by the Germans from both zones for service in other parts of Europe and to rehabilitate the Alsace-Lorraine lines. It was estimated in June 1941 that 150,000 out of a total of some 450,000 goods wagons (mostly 20-ton vehicles) had been requisitioned, and also about 3,000 locomotives, mostly of heavy and powerful types. A second adverse factor is the scarcity of fuel, which affects the whole of France. In the Occupied zone all traffic of course has to give way to German military requirements, but apart from this the French railways are treated as a single unit as far as supplies of coal and fuel oil are concerned. Coal shortage was responsible for the closing of a number of the closely spaced Métro stations in Paris, in order to save electric current, and apart from this it is noticeable that train services on the electrified lines, which are fed by hydro-electric power stations, have been rather better than those on steam-operated lines. The shortage of oils—heavy fuel oils, petroleum and lubricating oil—has resulted in the virtual disappearance of rail car services, and also the curtailment of the numerous bus services which for some years before the war had been increasing rapidly in mileage as part of a policy adopted by the S.N.C.F. of abandoning a large number of rural branch lines.

Although the Germans exercise a strict control over the movement of passengers and goods across the demarcation line separating the two zones, train services are in most cases continuous across the line, the stop for examination occurring at the first convenient station in the Occupied zone. Usually one or more stations in the neighbourhood of the actual frontier have been closed to traffic.

Passenger traffic on the French railways increased substantially during 1941, even over pre-war figures, despite increases in fares and the restriction of services to less than one-third of the pre-war



number. The virtual suspension, owing to the oil shortage, of all road transport, except the railway-owned buses, no doubt contributed very largely to this. As to goods traffic, many of the normal streams continue to flow, e.g. coal from the northern coalfield to Paris, and 'primeurs' northwards from the south-east. The fish traffic of the Channel ports has virtually ceased, but the stagnation of normal traffic in the coastal area has to some extent been relieved by the carriage of materials for the construction of aerodromes and fortifications.

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1. There is no single recent work, either in English or in French, on the railways of France, but there is an abundance of periodical literature, both technical and popular. The principal journals which have been consulted are:

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French: *Bulletin de l'Union Internationale des Chemins de Fer* (Paris, monthly); *Révue Générale des Chemins de Fer* (Paris, monthly); *Transports* (Paris, monthly); *L'Etat notre réseau* (Paris, monthly); *Nord magazine* (Paris, monthly).

2. History: Useful paragraphs on railways in G. Levasseur, *Histoire du commerce de la France*, vol. 1 (Paris, 1912). Valuable articles in *Bulletin de l'Union Internationale des C. de F.*, Feb. 1925; *Révue Générale des C. de F.*, July 1928, October 1938; also special number of *Révue Générale des C. de F.*, issued for International Railway Congress, May-June 1937.

3. Gradient profiles: Special supplement to *Railway Gazette*, 21 May 1937, also articles in *Railway Magazine*, 1934 and 1935.

4. Traffic: Various articles in the periodicals mentioned above.

5. Métro: J. Virgitti, *Les installations du chemin de fer Métropolitain de Paris* (Paris, 1933).

6. Statistics: *Statistique annuelle des ch. de f. français* (Paris, latest edition 1936). Later figures for the S.N.C.F. as a whole are given in *Statistique Internationale des Chemins de Fer*, 1938 (Paris, 1939).

7. Maps: *Atlas de France*, plates 57, 58 (Paris, 1935-6). Carte des Chemins de Fer Français, scale 1:800,000, issued by the S.N.C.F. (see vol. 1, p. 240, of this Handbook).

## Chapter V

### ROADS

Introduction: Historical Background: Geographical Description: Snow-blocked Roads: Bibliographical Note

#### INTRODUCTION

France is particularly well supplied with roads, the network of 630,000 km. (nearly 400,000 miles) giving a density second only to Britain in relation to area, and easily first in the world in relation to population. There are 2 miles of road for every square mile of country (or 1 mile to 0.54 sq. mile). By comparison, Great Britain has 1 mile of road to 0.44 sq. mile, Germany 1 mile to 1.37 sq. miles, Belgium 1 mile to 1.80 sq. miles, Spain 1 mile to 3.02 sq. miles and Italy 1 mile to 3.03 sq. miles.

Expressed in terms of population, France has 1 mile of road for every 107 inhabitants, compared with figures for Britain of 256, Germany 527, Belgium 1278, Spain 401 and Italy 1076.

#### HISTORICAL BACKGROUND

As in Britain, the foundation of a road system was laid by the Romans, who built some 4,000 km. (2500 miles) of highways (Fig. 104). For the Romans, Gaul occupied an intermediate position between Italy and their outpost of Britain, and the road network for the most part linked the western and north-western ports with Italy. There were two great route centres: Lyons (Lugdunum), on which point converged several trans-Alpine routes, and from which diverged roads to Spain, Bordeaux, Brest, Cherbourg, Boulogne, and the Rhineland; and Reims (Durocorter), centre for military operations towards Britain and the Rhenish frontier provinces. Paris (Lutetia) had not yet achieved any great degree of nodality. The development of the modern network, in which the lines of the Roman roads are easily traced, may be said to have been begun early in the seventeenth century with the creation by Henry IV of the office of Chief Road Surveyor ('Grand Voyer'). The first holder of this ministerial post was Sully, who inspired the creation of the 'routes royales', joining all the important towns with each other, and whose law of 1607 contained principles which still



form the basis of French road legislation.\* During the eighteenth century Louis XV established the 'École des Ponts et Chaussées' which was to provide for the recruitment of a trained body of road

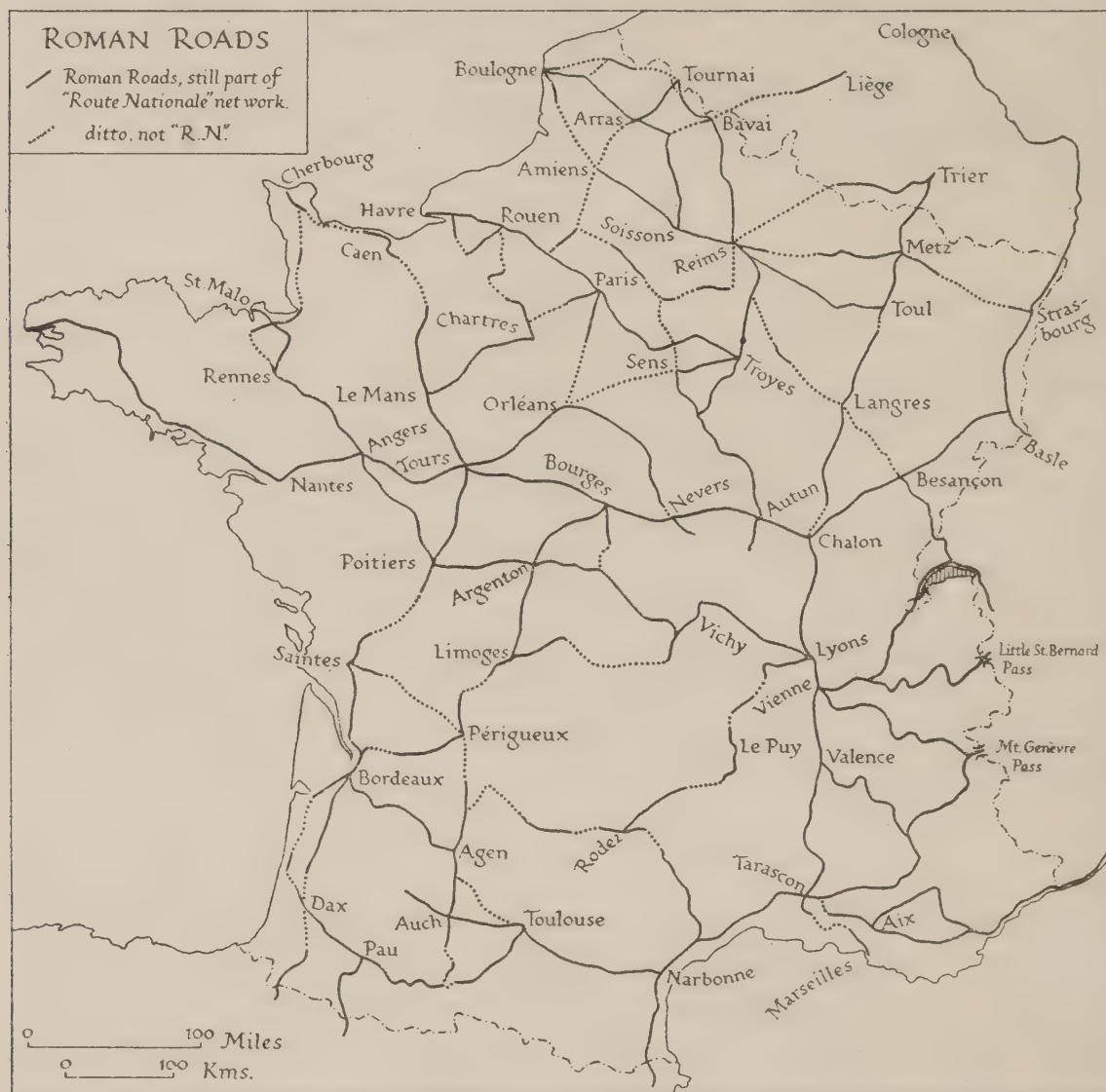


Fig. 104. Roman roads

The Roman roads are still largely represented in the *Routes Nationales* network of to-day. Where the physical circumstances offer very obvious routes, e.g. in the Alpine valleys, Rhône valley, Loire valley, the modern roads follow the track of the Roman highways over long stretches. Elsewhere the main 'modern', i.e. largely eighteenth century, roads sometimes chose easier if less direct courses, or passed through terrain which two thousand years ago was not in a suitable condition for road building, e.g. through poor drainage or forest cover.

engineers. The cost of building the roads was defrayed partly by tolls (cf. the English 'turnpikes') and partly, as in England at an earlier period, by statutory labour. By the time of the Revolution, a network

\* For the post roads of the seventeenth century see vol. II, p. 74, of this Handbook.

of some 40,000 km. (25,000 miles) had been constructed. Napoleon I introduced a new principle by classifying the road system into 'routes impériales' (later known as 'routes nationales'), comprising 229 main roads linking Paris with the main provincial towns and the latter with each other, and 'routes départementales'; the former were to be built and maintained from state funds, the latter by the departmental administration.

The road map of the Napoleonic period is very different from that of Roman times. The old Roman transverse routes were diverted to converge on Paris, which thus became the centre of a spider's web pattern of roads old and new. There was a great increase in the density of the 'strategic' road network in the north and north-east, though in the centre and south-west the mileage differed little from that of the Roman period, some of the Roman routes having been abandoned and some new ones created.

The disrepair into which the road system had fallen during the war period was remedied during the three decades after 1815 (in which year there were 33,161 km., only about 20,000 km. of which were considered passable!) by the expenditure of a great amount of money and by the employment of methods of construction and surfacing which had been developed in England by Macadam, Telford and others.

The national roads were made 4-5 m. wide, paved or macadamized, and bordered by avenues of trees; they were admirable means of communication for horse vehicles, animals and pedestrians. By 1847 the length of national roads had risen to 36,000 km. and of departmental roads to 44,000 km. Then, however, state and departmental interests and finances were turned towards the provision of a railway network, and the roads were looked upon as mere accessories to the railways. As late as 1895, indeed, there was a motion before the Chamber of Deputies proposing to turn over the 'routes nationales' to departmental control. But if the coming of the railways caused a diminution in importance of the main roads it increased the value of the local roads, the 'chemins vicinaux' which acted as feeders (see p. 317), and on which the communes were obliged to spend certain sums by a law of 1836.

Three inventions towards the end of the century brought about a renewed interest in road communication; they were the pedal cycle, the internal combustion engine and the pneumatic tyre, the latter two being combined in the automobile. France, with its miles of straight, paved highways, was perhaps better able to accommodate the new



and fast-moving motor vehicles than many other countries; but the main functions of motor transport during the first two decades of the present century were the serving of local traffic, and the departmental and local roads, created for slow-moving horse traffic, were certainly ill adapted for motor vehicles.

The phenomenal development of the motor car, coach and lorry since the war of 1914-18 has not only provided the railways with a formidable competitor, but has rendered necessary the complete resurfacing of the road system. In 1913 there were but 90,000 motor vehicles in the whole of France, and the state expenditure on roads amounted to only 34 million francs. In 1937 the total approached 2,200,000, of which nearly half a million were lorries, and over  $1\frac{1}{2}$  billion francs were spent. The magnitude of the task of reconstruction was so great that in 1923-4 the national roads were divided into classes and eight main trunk routes and fifty-one subsidiary highways were selected for immediate treatment. These were remodelled and widened to 5 or 6 m. The progress of motor traffic was so rapid, however, that in 1930 it was deemed necessary in the national interest to increase the number of roads classed as 'routes nationales' and maintained by the state, and as from 1932 the national road system was doubled in length, reaching a total of 80,000 km. At the beginning of 1934 the old system comprised 18,000 km. of roads less than 6 m. wide, 4,000 km. of 7 m. width and only 800 km. of the 9 m. width which was considered to be a desirable standard for the principal trunk highways. Of the 40,000 km. of the new system, 24,000 km. were less than 6 m. wide, 12,000 km. were not even properly surfaced.

The state of the road system at the end of 1936 was as follows:

	km.
National roads	80,200
Departmental roads	5,600
Local roads:	
'Chemins de grande communication'	166,600
'Chemins d'intérêt commun'	81,700
'Chemins vicinaux ordinaires'	297,000
Total	631,100

The departmental roads were maintained at the expense of the departments, but since it was legally possible to declassify these roads and incorporate them in the local system, which received a state subsidy, the length of such roads declined rapidly, and from 48,000 km. in 1870, it had fallen to 18,000 km. in 1920, and 5,000 km. in 1936. A further reclassification was therefore brought about by a law of 1938





Plates 73, 74. Routes Nationales

Straight tree-lined avenues are characteristic of the Napoleonic road system of France. In Plate 73 (above), on the Flanders Plain, the trees are Lombardy poplars; in Plate 74 (below), near Toul, they are fruit trees.





Plates 75, 76. Routes Nationales

Plate 75 (above) shows the typical *pavé* road surface of northern France; in an area where the subsoil is soft and yields no road metal, granite setts are imported from other areas. The surface is extremely durable, but rather uncomfortable for cyclists, hence the provision of a *piste* or cycle track on the left-hand side. The road is R.N. 16 near Hazebrouck. Plate 76 (below) shows R.N. 25 near Lens in course of reconstruction with a concrete surface.



which grouped into a new category of 'chemins départementaux' the departmental roads and the two major classes of local roads. Thus in 1939 there were but three classes of roads—Routes Nationales (80,200 km.), Chemins Départementaux (253,900 km.) and Chemins Vicinaux Ordinaires (297,000 km.).

The Routes Nationales are administered for the state by the Minister of Public Works, and the portion of the network in each department is controlled by a chief engineer from the department of Bridges and Highways. The departmental roads are administered by the departmental authorities under the direction of the Minister of the Interior; they are financed by the communes and departments with the aid of state subventions for new works and for the maintenance of sections used by specially heavy traffic. The ordinary local roads are maintained by the communes, sometimes aided by state and departmental finance for special works.

The growth of motor traffic, and to a less extent the need for creating work in order to relieve unemployment, led to considerable sums being spent on road works during the years immediately preceding 1939. The following were the main items in the programme:

(i) *Widening and resurfacing.* About 20% of the national road mileage was to be widened to take three lanes of traffic, a few short stretches on the outskirts of Paris being designed for more than three lanes. In 1939 there were 1800 km. of road with 9 m. width, 10,000 km. with 7 m. width, 64,400 km. between 4·5 and 7 m. wide, and only 4,000 km. under 4·5 m. About 74,000 km. of road were tarred, and of this total 39,000 km. were specially surfaced to permit of fast traffic.

(ii) *Flattening of camber.* Many lengths of road, especially in the long flat stretches which are so characteristic of France, had been constructed with a considerable camber, in order to facilitate drainage. The replacement of slow-moving horse vehicles, keeping to the crown of the road, by fast-moving automobiles, rendered this camber dangerous, especially when the surface was made slippery by wet, frost or snow, and accordingly improvements were necessary.

(iii) *Suppression of level crossings.* There are some 35,000 level crossings in France, of which 5,000 are on the national roads. To remove them all was estimated to cost 30 billion francs, a programme which, obviously impossible, was whittled down to the elimination of 3,000 of the most dangerous at a cost of 2 million francs. Effort was concentrated in the first instance on the replacement of level crossings in the Paris region by subways or over-bridges.



(iv) '*International*' roads. The French national road system is so good, and the routes taken by the main highways so straight and direct, that the construction of special motor roads, such as the German 'autobahnen' and Italian 'autostrade', was rightly considered unnecessary. It was calculated that existing trunk highways between Paris and the frontiers could be improved at a cost of about 600,000–700,000 francs per km., compared with 5–6 million francs per km. for the cost of completely new motor roads. Widening, resurfacing and the construction of by-passes round the main urban areas were envisaged, and a three-stage plan was formulated. In the first stage, the following roads were to be dealt with: Paris-Strasbourg (part of N. 3 and N. 4), Paris-Lyons (N. 6), Calais-Arras-Vitry-le-François (parts of N. 43, 39, 37, and 44), Paris-Bordeaux (N. 10). The second stage comprised Paris-Lille (N. 17), Lyons-Ventimiglia (N. 7), Bordeaux-Avignon (N. 127 and N. 99), and the third stage Paris-Cherbourg (N. 13), Bordeaux-Hendaye (N. 10), Paris-Nevers-Lyons (N. 7), Narbonne-Le Perthus (part of N. 9), Châlon-sur-Saône-Geneva (parts of N. 78 and N. 5), Paris-Havre (N. 14). Only the first section of the plan had been embarked upon before the outbreak of war in 1939.

(v) *The improvement of the means of egress from Paris.* Five main radiating motorways, with twin traffic lanes, each 9 m. wide, were visualized, at a cost of one billion francs. Only one of these—the Porte St Cloud exit from the city, leading to Versailles (N. 10 to Bordeaux, N. 12 to Brest)—was in progress in 1939.

(vi) *Tourist roads.* The improvement of motor roads in the Pyrenees and Alps was obviously a task which would pay for itself indirectly by the encouragement given to visiting motorists. Three main roads were concerned: the 'Route des Pyrénées' from Biarritz via Eaux Bonnes, Bagnères de Luchon and Aix-les-Thermes to Perpignan, the famous Corniche road along the Riviera coast, and the 'Route des Alpes' from the shores of Lake Geneva to Nice. The last-named road, which crosses the Col d'Iseran at 2,770 m., the highest through-road summit in Europe, is still incomplete, and the section from St Gervais to Bourg St Maurice across the Bonhomme Pass (2,670 m.), which was begun in 1938, and estimated to take five years, was the only major piece of new road construction in progress at the outbreak of war.

## GEOGRAPHICAL DESCRIPTION

The network of Routes Nationales is shown in Fig. 105. The most striking feature of the map is the evenness of the 'mesh' throughout the country, a reflexion of a policy resembling that which lay behind the provision of a railway network of more or less uniform density



Fig. 105. The network of national roads

(see Fig. 65). A map showing the complete road system would not show quite the same features, for in the physically difficult areas (e.g. the Alps, Pyrenees, and Central Massif) a greater proportion of the total road mileage falls within the 'route nationale' classification than is the case, for example, in the great lowland farming areas, where, although the total mileage is greater and the network correspondingly denser, most of the roads fall within the departmental and local classification.



On Fig. 105 the nodality of Paris, and the density of the road network around it, are striking features; other areas of greater than average density are the northern industrial area, the Lorraine ironfield and the 'tourist' areas of Savoy and the west-central Pyrenees. The areas of least density are the Landes (where indeed there are relatively few roads of any class), the southern end of the Central Massif, and the

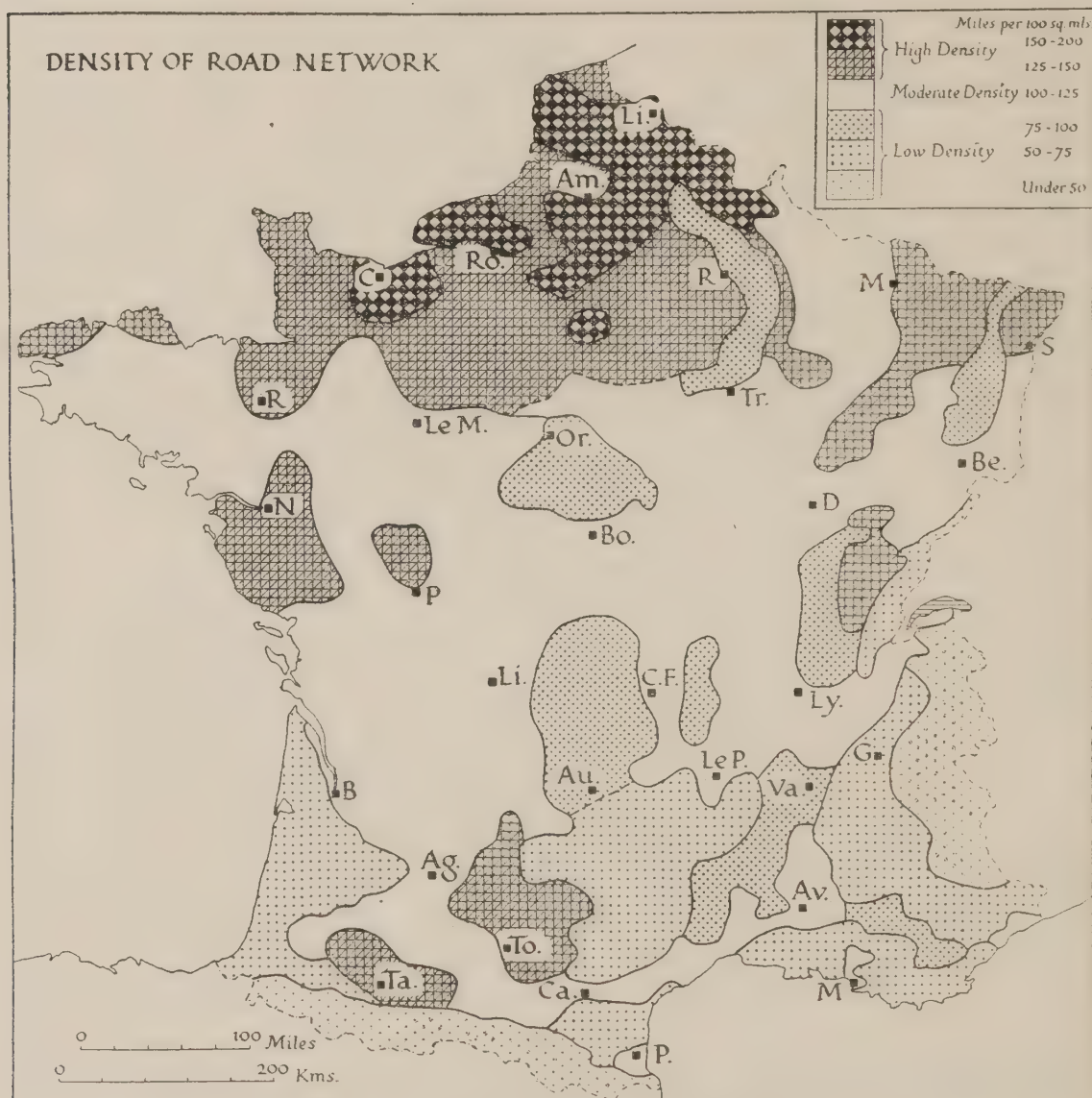


Fig. 106. Density of road network

For explanation see text.

high Alps. The road-nodality of many important towns is readily appreciated (e.g. Rennes, Le Mans, Toulouse, Lyons, Dijon).

To counteract the impression of even density given by Fig. 105, Fig. 106 has been constructed to show the density of the complete road network. On this map, all areas having a moderate or average density, roughly between 100 and 125 miles of road to 100 sq. miles of country,

are left blank; all areas having a lower density than this are dotted; areas having a higher density than the average are ruled or covered with black squares. In most cases the boundaries of the areas delimited are readily apparent from a road map; elsewhere the change of density is more gradual, and on the map such changes are represented by interrupted lines. A number of easily recognizable features of geographical significance deserve comment:

(1) The main areas of low density, as might be expected, are the mountainous regions—the Alps, Pyrenees and Central Massif—

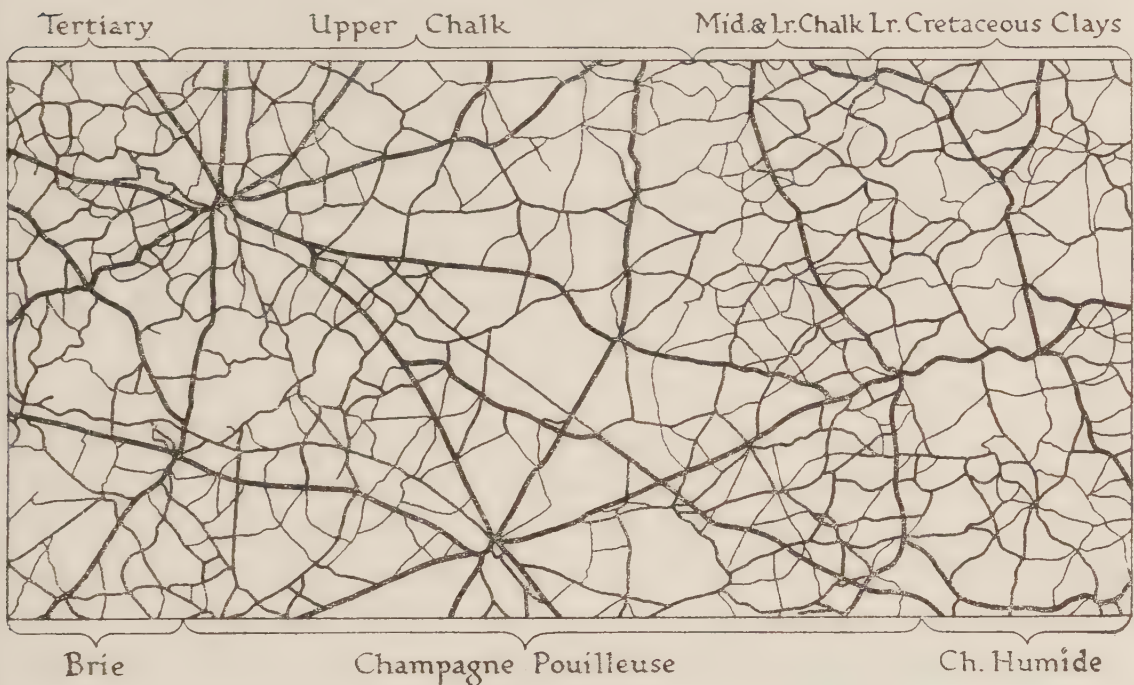


Fig. 107. The road network of an area extending east-west across Champagne

The three main road classes (national, departmental and local) are indicated by different thicknesses of line. The road focus in the north-west is Reims, that in the south centre is Châlons-sur-Marne. The influence exerted by the geology on the patterns of human life is a characteristic feature of the whole of the Paris basin; one aspect of this is clearly indicated in this map (compare vol. 1, chapter 1 of this Handbook). The scale of the map is approximately 15 miles (24 km.) to 1 in.

together with the Jura and Vosges. Of low-lying areas five stand out clearly, the Landes, the Sologne, Dry Champagne (see also Fig. 107), the Rhône delta, and the trough of Bresse and Dombes.

(2) The main areas of high density are in the north and north-west; this is in part a response to the rich agricultural environment and dense rural population of the Paris region and the loam-covered chalklands of Flanders, Artois, Picardy and Normandy, and is in part due to the existence of the industrial area on and around the northern coalfield. Other areas of high density are the northern coastlands of



Brittany, the Vendée, the Lorraine plateau, northern Alsace, the Jura plateau (between the Bresse trough and the Jura fold-ranges), south-eastern Aquitaine (Toulouse-Cahors region) and the low plateaux of Gers and Lannemezan.

As a specimen of the nature of the road network and of the rapidity of its changes of character and density, Fig. 107 illustrates the pattern in an area within the eastern part of the Paris basin, stretching across several different geological formations and 'pays'.

### SNOW-BLOCKED ROADS

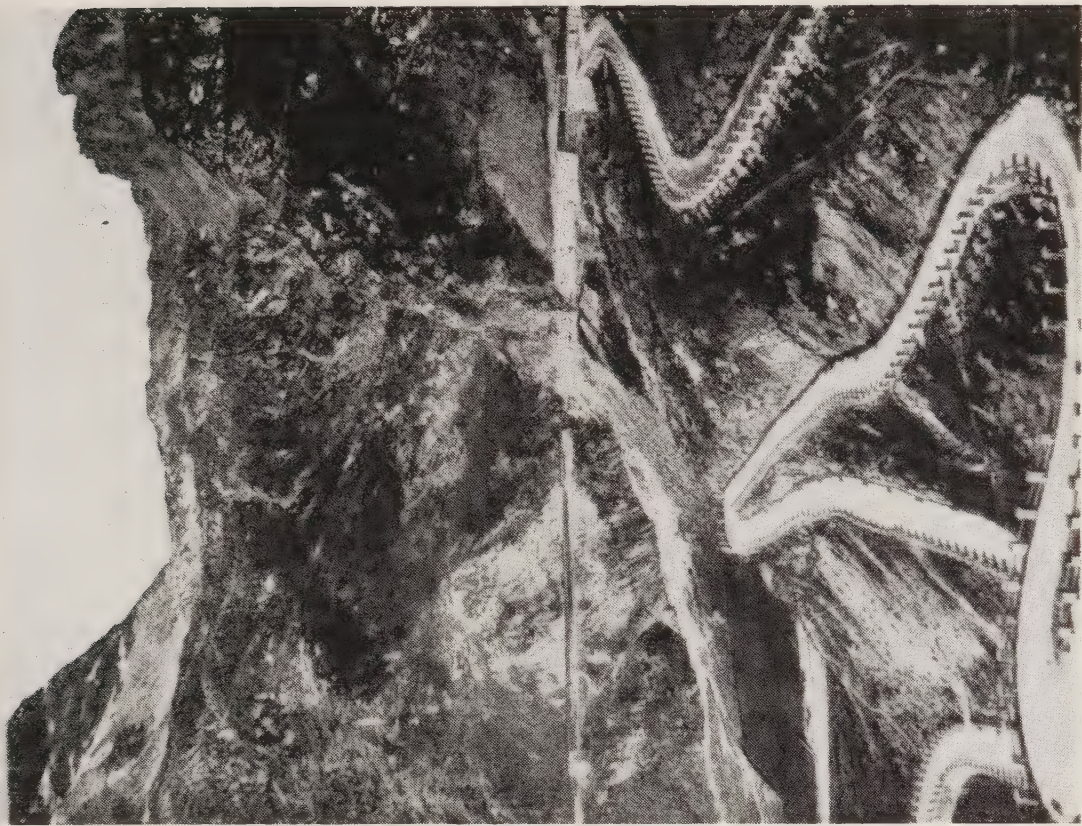
In several areas of France the frequency and extent of winter snowfall is sufficient to cause serious interruption to road communications.\* The tables which follow indicate where and for how long the danger from snow is present, and Figs. 108, 109 and 110 interpret this and other information cartographically. The conditions in the three main highland areas—Alps, Pyrenees and Central Massif—differ somewhat by reason of altitude, latitude, and aspect.

In the Alps, interruption of road communication by snow is rare below 1000 m. (3,300 ft.) except in certain valleys where drifting rather than the heaviness of the fall is responsible, e.g. the Verdon and other valleys of the Alps of Provence. The stretches of road on which intermittent blocking—generally cleared after the lapse of a few days—may be expected during the months December to April inclusive is shown on Fig. 108. Most of the passes above about 1,300 m. (approx. 4,300 ft.) are completely blocked for periods of 6–8 months, though the Mont Genève, at almost 6,100 ft., is able to be kept clear except after severe snowstorms; it is noteworthy that the Romans used this pass as their chief Alpine crossing (cf. Fig. 104).

In the Pyrenees, the more southerly latitude is offset by the decidedly heavy winter precipitation, i.e. more concentrated snowfall, and this, combined with the intricate dissection, with abundant valleys in which snow may drift, produces temporary snow-blocking on many roads at altitudes below 1,000 m. West of the Roncevaux gorge, which is only intermittently blocked, road traffic is practically free from interruption due to snow, and at the eastern end of the range the low altitude of the Perthus pass (just under 300 m.) renders the Perpignan-Barcelona road quite free from blocking. The Central Pyrenees, however, suffer severely, and interruption of traffic over the passes for from 4 to 8 months is general.

\* For snowfall and snow-cover, see vol. 1, pp. 216–21 of this Handbook.





Plates 77, 78. Zigzag roads in mountain regions

Plate 77 (left) shows the Cauterets valley, in the central Pyrenees; R.N. 21 *c* leads to the spa and winter sports centre of Cauterets, and the valley is also followed by a narrow-gauge railway. Plate 78 (right) shows the road (R.N. 6) ascending to the Mont Cenis pass.





Plates 79, 80. Snow-blocking

Plate 79 (above) shows the road over the Col d'Iseran (R.N. 202) at midsummer, at the beginning of its short four-months open period. Plate 80 (below) shows a powerful motor snow plough on the Somport road (R.N. 134) south of Pau.



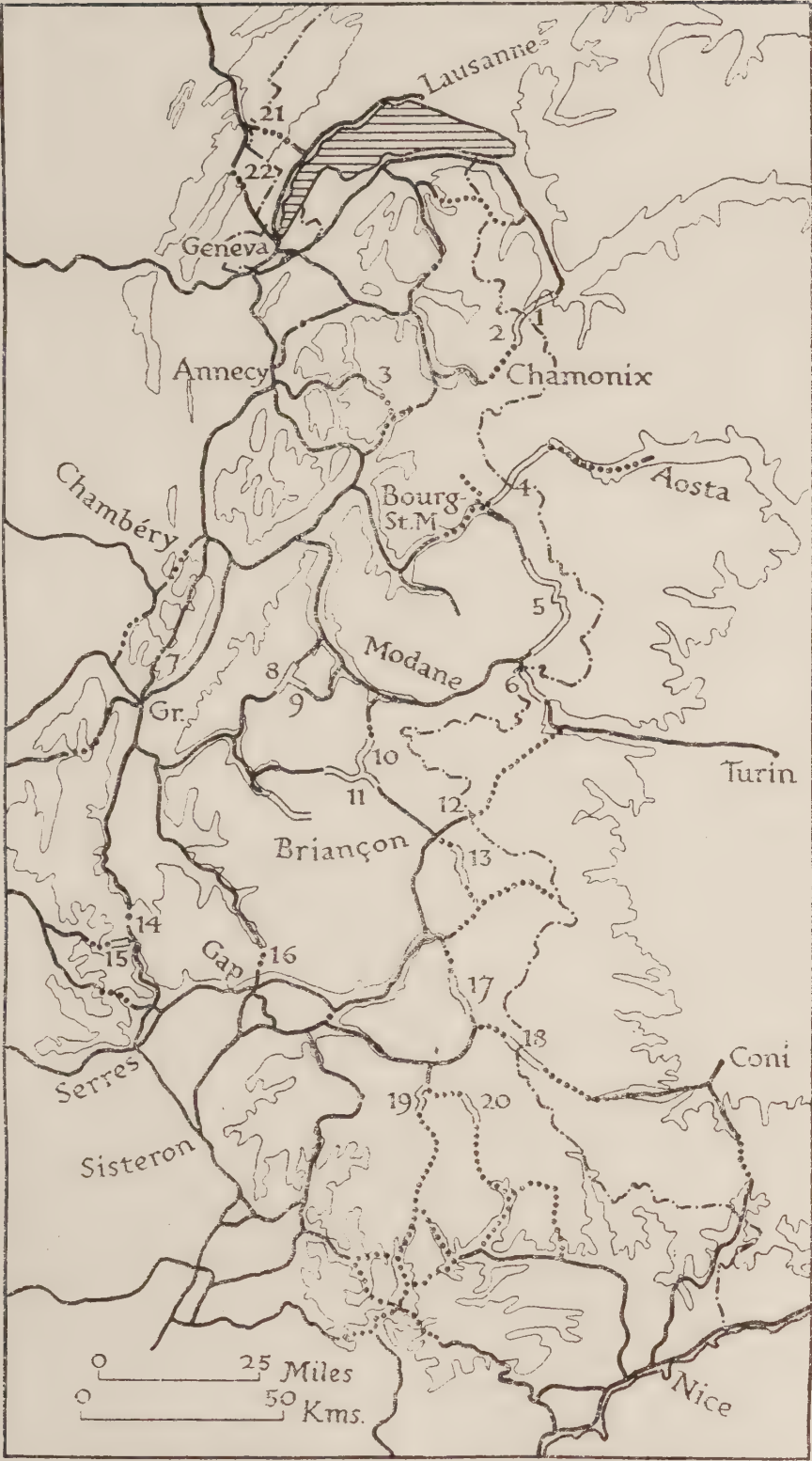


Fig. 108. Snow-blocked roads in the Alps and Jura

The 1,000 m. contour is shown. Roads shown by solid lines are never blocked; dots indicate sections subject to intermittent blocking; double lines represent sections completely blocked for several months (see table on p. 344). Gr. = Grenoble.



In the Central Massif irregular snow-drifting is to be feared over a very wide area, particularly above 1,000 m., but also on many roads below this level, and despite the lower altitude and less mountainous character of the massif than of the Alps or Pyrenees, interruption of road traffic may in a way be regarded as more of a nuisance because it is less regular and reliable. On the higher stretches of road, above about 1,100 m. (3,600 ft.), intermittent blocking lasting more than a

*Table of Snow-blocked Roads*

Pass	Altitude m. ft.		Blocked	Road no.	Route
A. ALPS. (From north to south.) (Numbers refer to Fig. 108.)					
1. Forclaz	1528	5013	Late Oct.—mid May	*	Geneva-Chamonix- Martigny (Switz.) Annecy-Flume Moutiers-Bourg St Maurice-Aosta (Italy) 'Route des Alpes', Bourg St Maurice-Lanslebourg Chambéry-Modane-Susa (Italy) Grenoble-Chambéry Clelles-La Chambre Clelles-St Jean de Maurienne St Michel-Col du Lautaret Grenoble-Briançon Briançon-Cesanne (Italy) Briançon-Guillestre Grenoble-Aspres Die-Croix-Haute Grenoble-Gap Guillestre-Barcelonnette Gap-Coni (Italy) Barcelonnette-Annot Barcelonnette-Guillaumes
2. Montets	1461	4793	Mid Nov.—early May	N. 506	
3. Aravis	1498	4915	Mid Nov.—mid May	N. 509	
4. Little St Bernard	2157	7178	Late Oct.—mid June	N. 90	
5. Iseran	2770	9088	Mid Oct.—late June	N. 202	
6. Mt Cenis	2083	6834	Late Oct.—late May	N. 6	
7. Porte	1325	4347	Intermittent Dec.—Mar.	N. 512	
8. Glandon	1951	6401	Mid Oct.—mid June	N. 526— 527	
9. Croix de Fer	2088	6850	Mid Oct.—mid June	N. 526	
10. Galibier	2658	8399	Mid Oct.—late June	N. 202	
11. Lautaret	2057	6790	Early Nov.—mid June	N. 91	
12. Mont Genève	1854	6083	Intermittent Dec.—Apr.	N. 94	
13. Izoard	2409	7903	Late Oct.—late June	N. 202	
14. Croix-Haute	1176	3858	Intermittent Dec.—Apr.	N. 75	
15. Grimone	1320	4330	Late Oct.—mid May	N. 539	
16. Bayard	1246	4117	Intermittent Dec.—Apr.	N. 85	
17. Vars	2115	6939	Late Oct.—mid June	N. 202	
18. Larche	1995	6545	Early Nov.—mid May	N. 100	
19. Allos	2250	7382	Early Nov.—mid June	N. 208	
20. Cayolle	2352	7716	Mid Oct.—mid June	N. 202	
B. JURA. (Fig. 108.)					
Les Verrières	760	2500	Intermittent Dec.—Mar.	N. 72†	Pontarlier-Neuchâtel (Switz.)
21. St Cergues	1235	4051	Intermittent Dec.—Mar.	—†	Les Rousses-Nyon (Switz.)
22. Faucille	1320	4331	Intermittent Dec.—Mar.	N. 5	Les Rousses-Geneva (Switz.)

\* On Swiss side of frontier

† Snow blocking on Swiss side of frontier (Swiss national road no. 10).

‡ Snow blocking on Swiss side of frontier (Swiss road no. 90).

Pass	Altitude m. ft.		Blocked	Road no.	Route
C. PYRENEES. (West to east.) (Fig. 109.)					
1. Ronces-valles*	1057	3468	Intermittent Dec.-Apr.	N. 133	St Jean-Pied-de-Port-Saragossa (Spain)
2. Somport	1640	5381	Nov.-mid May	N. 134	Oloron-Saragossa (Spain)
3. Pourtalet	1758	5768	Late Oct.-mid June	N. 134 bis	Pau-Saragossa (Spain)
4. Aubisque	1710	5610	Nov.-early June	N. 618	Lauruns-Argeles
5. Tourmalet	2114	6936	Mid Oct.-mid June	N. 618	Luz-Arreau
6. Aspin	1497	4911	Nov.-late May	N. 618	Luz-Arreau
7. Peyresourde	1545	5069	Nov.-late May	N. 618	Arreau-Luchon
8. Portet d'Aspet	1074	3524	Dec.-April	N. 618	Luchon-St Girens
9. Bonaigua†	2072	6798	Nov.-June	N. 125 c.	St Beat-Lerida (Spain)
10. Envalira‡	2407	7897	Early Nov.-late June	—	Ax-les-Thermes-Andorra-Lerida (Spain)
11. Puymorens	1914	6281	Nov.-mid June	N. 20	Ax-les-Thermes-Puigcerda (Spain)
12. Marmare	1360	4462	Nov.-April	N. 613	Tarascon-Les Cabannes-Quillan
13. Quillane	1722	5652	Nov.-late Mar.	N. 118	Quillan-Mont Louis
14. Jau	1513	4964	Nov.-June	G.C. 17	Quillan-Prades
D. VOSGES. (North to south.)					
1. Bonhomme	949	3114	Intermittent Dec.-Mar.	N. 415	St Dié-Colmar
2. Route des Crêtes	900-1360	2950-4450	Nov.-late May	N. 430, 431	Bonhomme Pass-Schlucht Pass-Cernay
3. Schlucht	1139	3737	Nov.-April	N. 417	Gérardmer-Colmar
4. Bramont	967	3173	Intermittent Dec.-Feb.	I.C. 13 b	Gérardmer-Thann
5. Ballon d'Alsace	1178	3865	Late Nov.-early Apr.	N. 465	Belfort-Remiremont
6. Route Joffre	740	2428	Nov.-May	I.C. 14 b	Meseraux-Thann
E. MASSIF CENTRAL. (North to south.) (Fig. 110.)					
1. Puy de Dôme (summit)	1465	4806	Intermittent Dec.-Apr.	N. 141 a	Clermont-Ferrand-Puy de Dôme
2. Guery	1264	4147	Nov.-Apr.	N. 683	Le Mont Dore-Randanne
3. Croix Morard (Dyane)	1401	4596	Dec.-Apr.	N. 496	Le Mont Dore-Issoire
4. Peyrol	1589	5213	Dec.-May	N. 680	Salers-Murat
5. St Bonnet-le-Froid	1139	3737	Intermittent Dec.-Mar.	N. 105	Yssingeaux-Annonay
6. Gerbier de Jonc	1450	4757	Dec.-Apr.	G.C. 36	Le Puy-Mezillac
7. Quatre Vios	1140	3740	Intermittent Dec.-Apr.	N. 535	Mezillac-Privas
8. La Bastide	1120	3674	Intermittent Dec.-Mar.	N. 106	Pradelles-Villefort
9. Mt Aigoual	1567	5141	Dec.-May	I.C. 169	Florac-Le Vigan

\* Snow-blocked section is on Spanish side of frontier (Ibaneta Pass).

† On Spanish side of frontier; poor road.

‡ In Andorra.



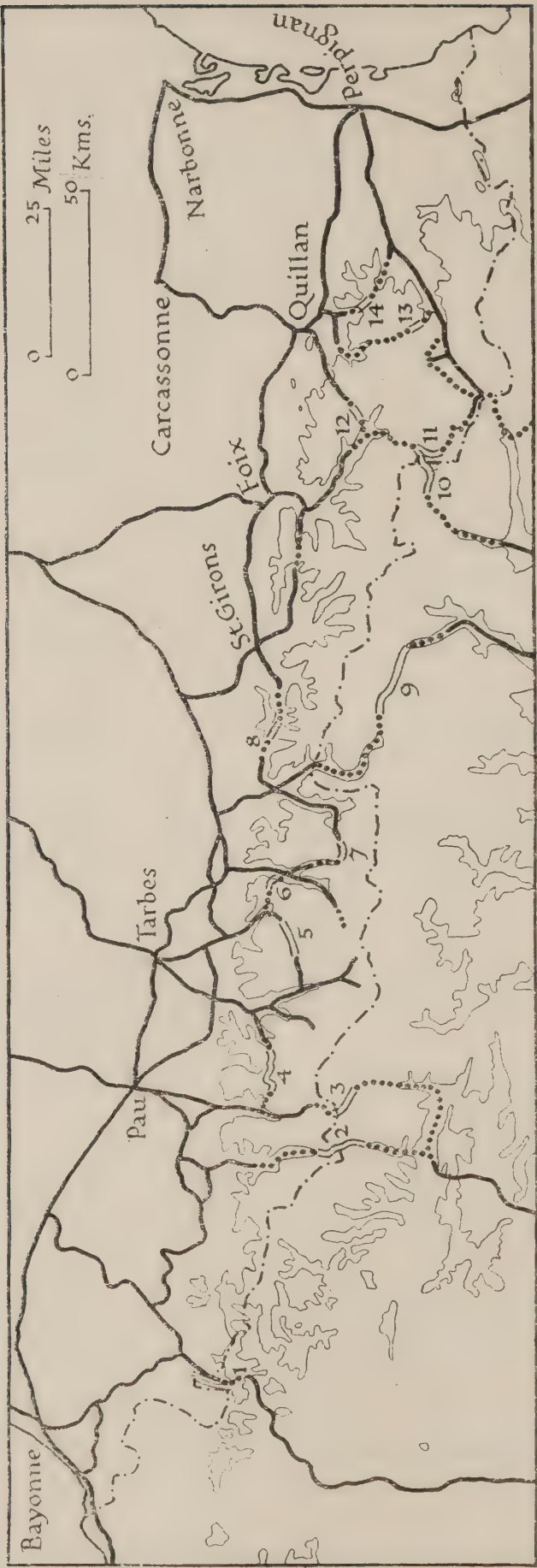


Fig. 109. Snow-blocked roads in the Pyrenees

The 1,000 m. contour is shown. Roads never blocked are shown by solid lines; those subject to intermittent blocking by dots; passes completely blocked for several months by double lines (see table on p. 344).

day or two may be expected after heavy snowfall, whilst on 'passes' above about 1,250 m. (4,100 ft.) complete blocking for about 4 months is likely.

Roads across the Vosges are liable to intermittent blocking over the summits for a period of about 3 months; one or two sections of road,

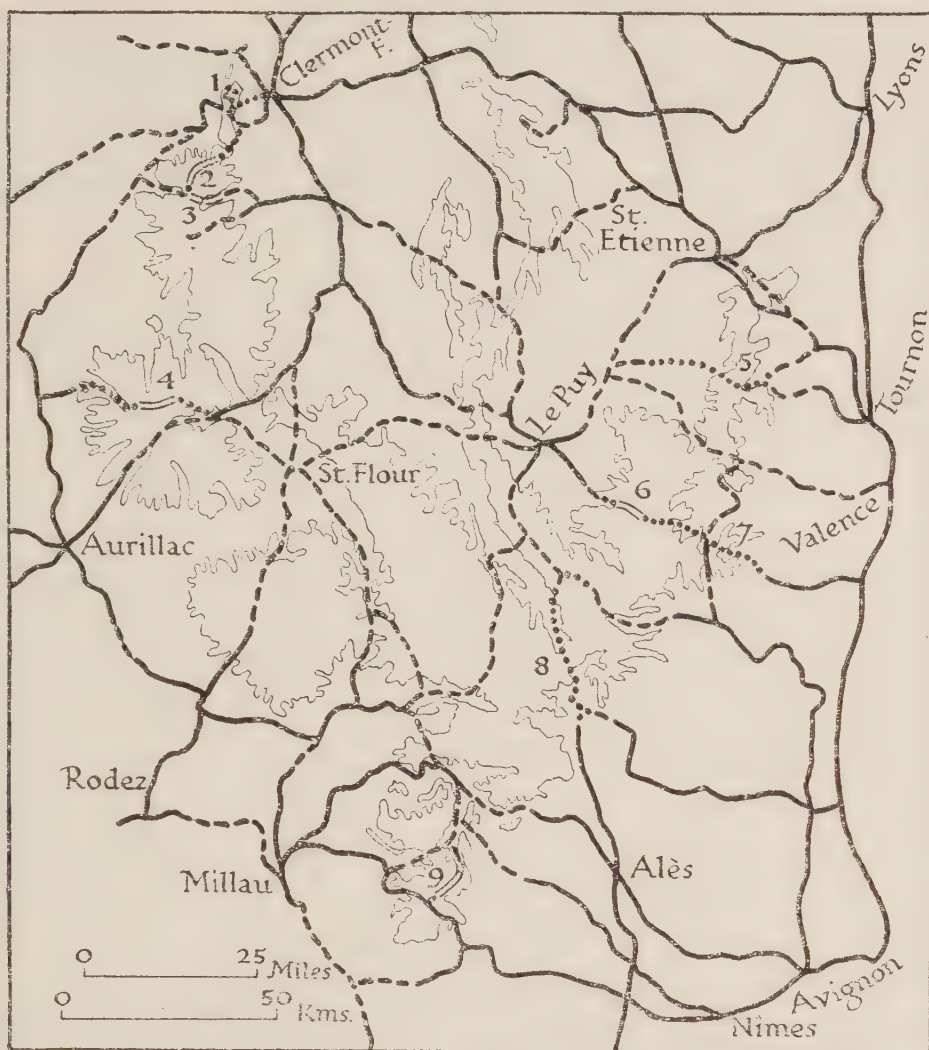


Fig. 110. Snow-blocked roads in the Central Massif

The 1,000 m. contour is shown. Roads always open shown by solid lines; those liable to intermittent blocking, but seldom for more than two days, by pecked lines; those liable to intermittent blocking lasting several days or weeks by dots; sections blocked for several months by double lines. For the last two classes see table on p. 344.

including the formerly strategic, now tourist, road along the summit, known as the 'Route des Crêtes', are completely snow-blocked for 4 or 5 months.

The Jura contain no road summits high enough to suffer from complete blocking; of the four main roads across the ranges, the Pontarlier-Lausanne route is usually quite free, and only the Faucille



Pass road suffers from interruption within the frontiers of France, the two remaining roads being intermittently snow-bound on the Swiss side (Fig. 108).

#### BIBLIOGRAPHICAL NOTE

1. Useful articles summarizing the history of French road development will be found in *Transports*, Nov. 1936 (Paris), and *Bulletin de l'Union Internationale des Chemins de Fer*, Oct. 1938 (Paris).

2. The *Guide Michelin*, issued annually (latest edition, Paris, 1939), contains, besides road plans of the major towns, general road maps and maps showing the location of snow-blocked sections.

3. Road maps are very numerous; the best are the Michelin series, scale 1:200,000, covering France in 37 sheets (see vol. 1, p. 247 of this Handbook). See also Plates 54 and 55 in the *Atlas de France* (Paris, 1934).

## Chapter VI

### WATERWAYS

Introduction: North-eastern France: Seine Basin: Eastern France: South-eastern France: Loire Basin: North-western and Western France: The Vichy Regime (to March 1942): Bibliographical Note

#### INTRODUCTION

France possesses a number of long natural waterways radiating from the heart of the country to the several coasts. Yet with one or two notable exceptions these rivers are of relatively little use for navigation. In some cases extensive canalization and regulation have improved them; along other rivers lateral canals have been constructed. But, on the whole, geographical conditions have limited the effective development of water transport in France to the north and east. Fig. 111 shows the concentration of main waterways in this part of the country. It is noteworthy that eight of the ten river ports which handled over one million metric tons of freight in 1936 are in this part of France. A relatively mature river system with gentle valley gradients, an evenly distributed rainfall, and the presence of industrial centres requiring the transport of bulk cargoes are all relevant factors favouring the north-east. The Seine, owing to its position, carries the heaviest tonnage of all French rivers; its navigational difficulties have been largely rectified by extensive flood regulation works. In southern France, owing to mountainous conditions, only the Rhône-Saône valley and the basin of the Garonne afford any possibility of large-scale water transport; of these, the first alone is related to industrial areas sufficiently important to warrant expenditure upon the necessarily huge schemes of water regulation. Moreover, in the Mediterranean area there are peculiar difficulties of climate, rock structure and water supply, and it is only in connexion with Marseilles that the necessary inducement has been forthcoming. Finally, the Loire, like the Garonne, is poor for navigation, owing to its irregular regime and variable channel. The mean annual volume of French rivers is shown in Fig. 112, although, of course, there is considerable seasonal fluctuation.



The Briare Canal serving the Loire ironfield was completed as early as 1642, and this was followed in 1681 by the Midi Canal linking the Mediterranean with the Atlantic. Napoleon included an extensive programme of canal building among his great schemes of public works, but the elaborate canal system of France was developed

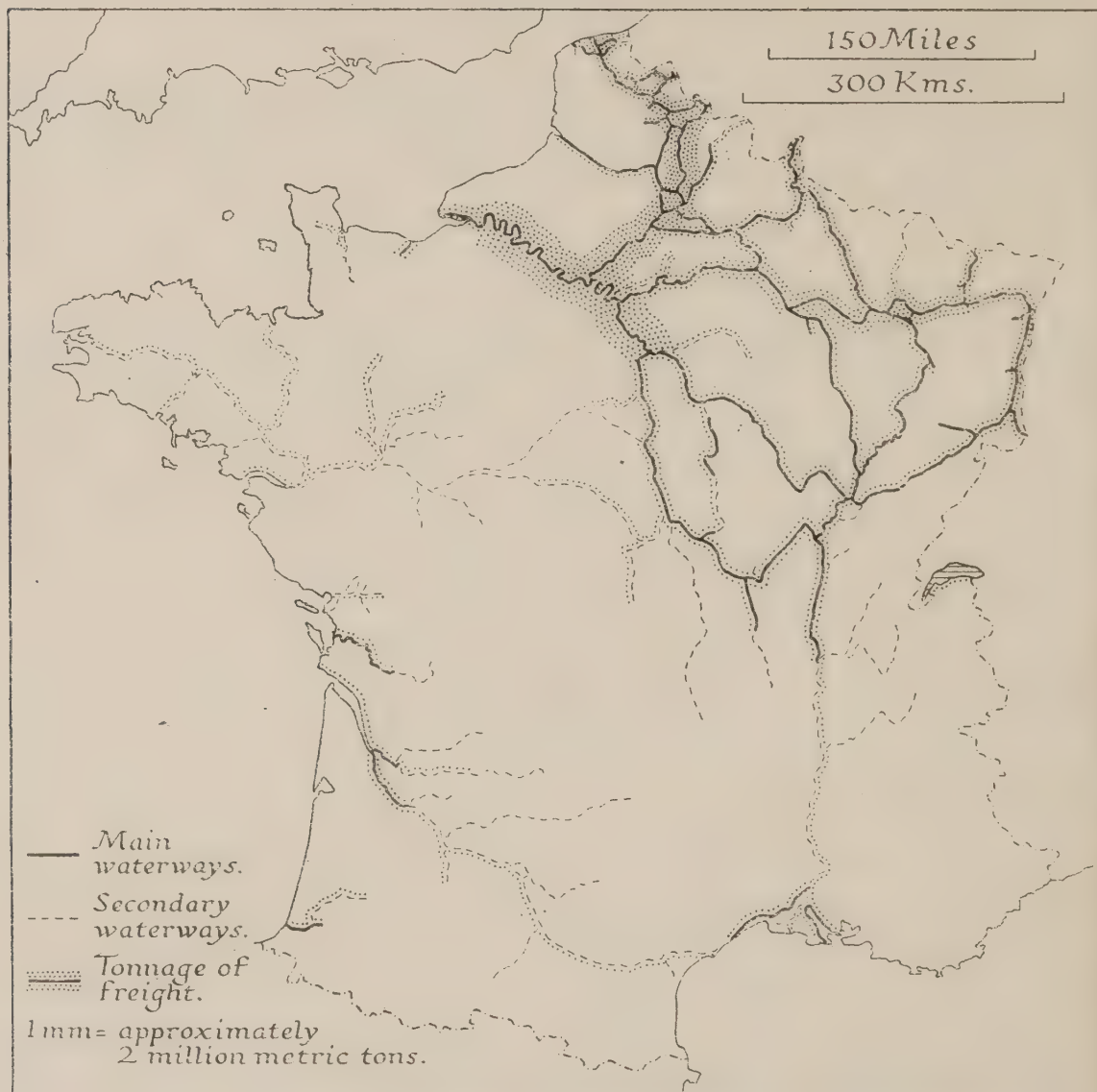


Fig. 111. Tonnage of freight conveyed on French waterways, 1936

Based on a map from *Atlas de France*, Plate 56 (Paris, 1936).

only after the Franco-Prussian War. It was initiated by the great engineer and statesman, Charles de Saulce de Freycinet. As Minister of Public Works from 1877, he carried a scheme through the *Chambre* for the development of the whole French communication system, and the act which governed the construction of canals and the regulation of waterways bears his name.

The *Freycinet Act* of 1879 laid down the following dimensions as

the minimum requirements to be aimed at for the main French waterways:

Depth	2.00 m.
Length of locks	38.50 m.
Width of locks	5.20 m.
Bridge clearance	3.70 m.

These minimum requirements were defined in order to allow the passage of the 300-ton Flemish barge or *péniche*, which accordingly became the standard vessel on the main canals (Plate 81). Some of the larger waterways, such as the Rhine and lower Seine, are able to take bigger craft known as the *chaland*. The dimensions of these craft are as follows:

Type	Length m.	Beam m.	Draught loaded m.	Capacity in metric tons
<i>Péniche</i>	35.00–38.50	5.00	1.80	250–300
<i>Chaland</i>	40.00–50.00	8.00	1.80	600

In addition small steamers and tugs, with a capacity of 100–200 metric tons, are used on many canals for hauling strings of ‘dumb-barges’ (i.e. not self-propelled) (Plate 91).

A number of waterways do not come up to the *Freycinet* requirements, and are ranked as second class; and there is also a category of streams that are not navigable in the ordinary sense, but are classified as *flottable*, i.e. raftable. They are used chiefly for floating timber and are outside the scope of this survey.

Since the war of 1914–18, there have been considerable developments on some of the French waterways. These have been stimulated by increasing competition with road and rail for a reduced traffic. These developments are for the most part designed to speed up traffic and generally to offer a more reliable service. Obstructions have been eliminated in the rivers by means of dredging, blasting, and by the construction of containing walls and dikes. Locks and bridges of inadequate dimensions have been removed or replaced by modern structures, and on those waterways where transport is heavy better provision has been made for two-way traffic. Moreover, slow horse-towage has been, to a considerable extent, replaced by electric tractors on rails along the towpath. Electric traction was first introduced in France on the St Quentin Canal in 1895, where three-wheeled tractors were used. Between 1904–7 tractors on rails were introduced, and during the reconstruction following the War of



1914-18 many waterways were equipped for mechanical haulage. By 1935 some 1,700 km. were so equipped, of which more than 800 km. were electrified, and 1,287 tractors, of which 1,105 were electrical, had been installed. The tractors run on metre-gauge lines (Plate 82)



Fig. 112. Mean annual volume of French rivers

Based on a map from *Atlas de France*, Plate 20 (Paris, 1937). The width of the stippled band is proportional to the outflow (0.5 mm. represents approximately 100 cu.m. per second).

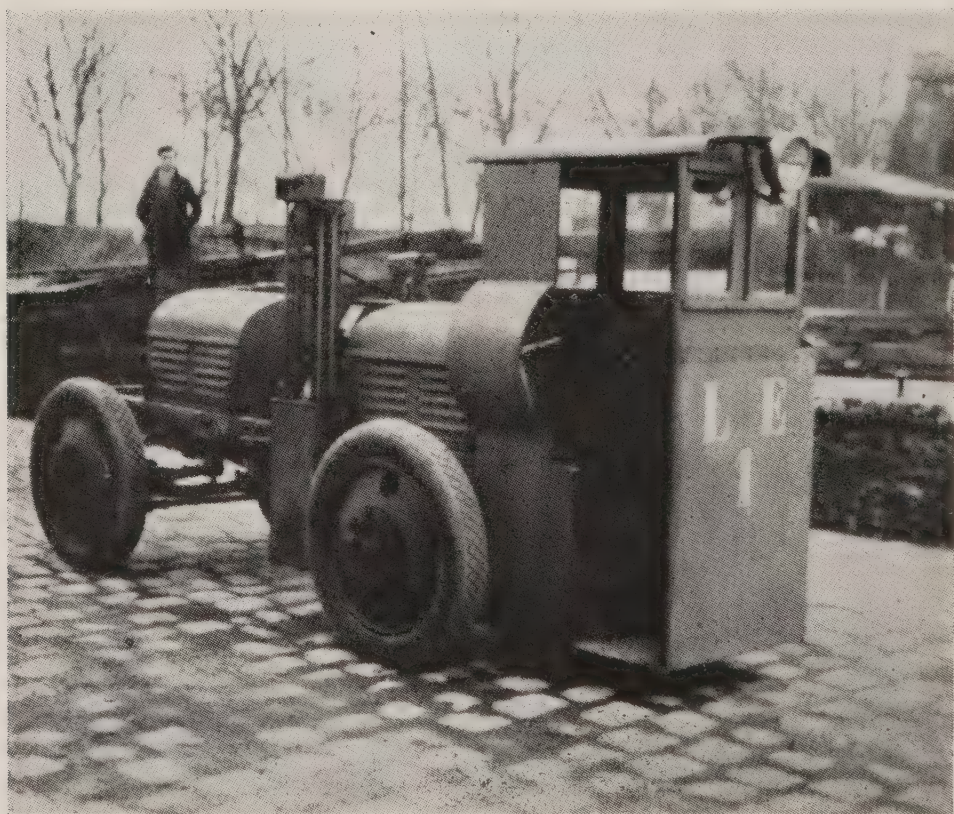
or less usually on tyres (Plate 83), fed from overhead trolley-wires. There is also electric manipulation at many locks and weirs, and electric haulage by underwater chains through some of the more difficult water-parting tunnels (Plate 85). The substitution, at a rapidly increasing rate, of self-propelled craft for the towed convoy makes for greater fluidity of traffic, for a quicker turn round



Plate 81. *A péniche*

The 300-ton Flemish barge is the standard vessel on the main French waterways. Nearly one-quarter of these barges are self-propelled. The illustration shows a simple form of a *bassin* or *garage*; on some of the larger waterways such *garages* have accommodation for 150-200 barges.





Plates 82, 83. Electric tractors for barge haulage

Plate 82 (above) shows a number of electric tractors which run on metre-gauge rails; Plate 83 (below) shows a rubber-tyred tractor, the motive power for which is obtained from overhead wires. A complete monopoly of mechanical haulage on the waterways of eastern France is owned by the *Compagnie Générale de Traction sur les Voies Navigables* (C.G.T.V.N.); its subsidiaries include *La Traction du Nord*, *La Traction de l'Est*, and *La Société Meusienne de Traction sur les Canaux*.

of available craft, and for a speedier response to local demands for cargo space. The total freight conveyed by mechanically propelled barges increased from 280,000 metric tons in 1920 to 12,629,000 metric tons in 1936, that is, from 1.2 to 26.4 % respectively of the total tonnage conveyed (Fig. 113).

The total length of the navigable waterways of France is about 9,700 km., of which some 3,200 km. are classified as secondary;

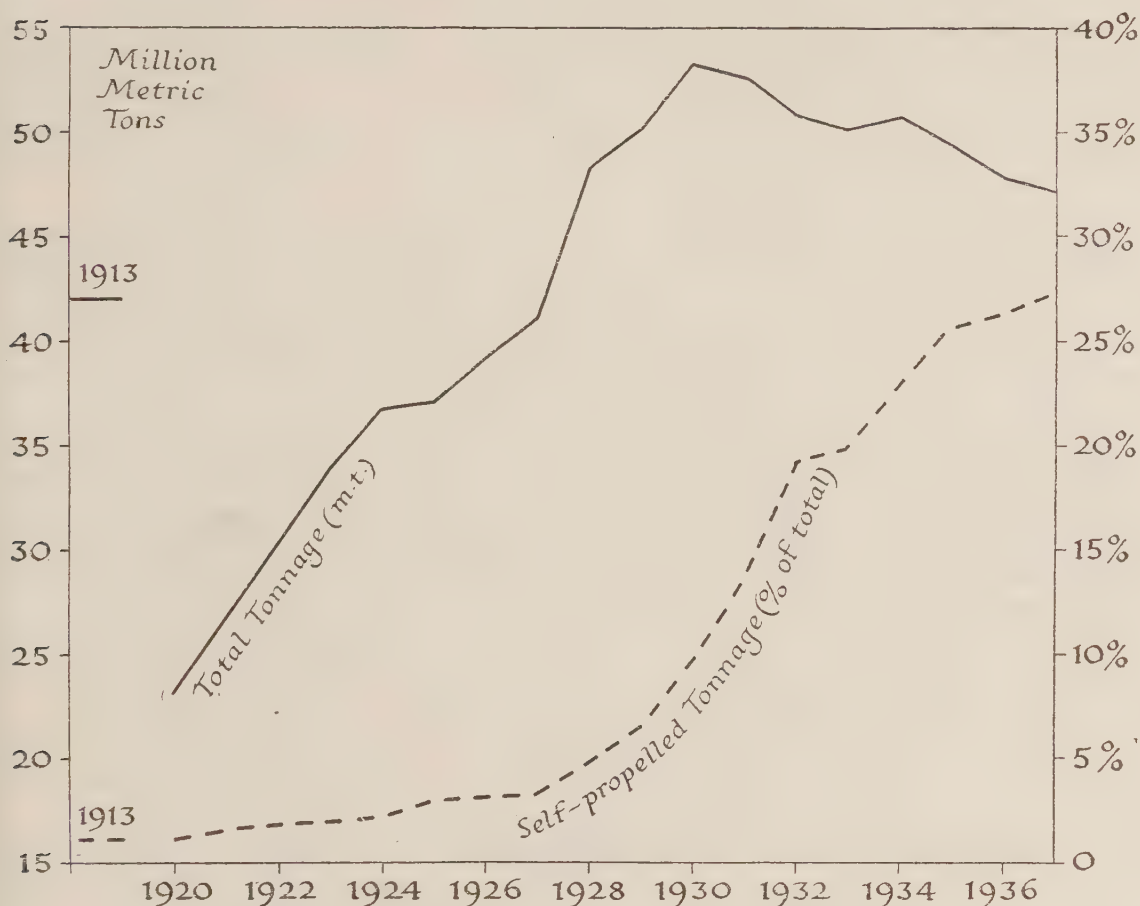


Fig. 113. Graph of (1) the total tonnage conveyed on French inland waterways, 1913 and 1920-37, and (2) the percentage of that tonnage carried in self-propelled barges. The rapid increase in the latter is very marked after 1927.

the average metric tonnage conveyed is normally between 45 and 50 millions per annum, as compared with approximately 200 millions by rail. Most of this tonnage is handled by 572 ports, of which in 1936 ten dealt with over one million and another fourteen with between 500,000 and one million metric tons.

In 1936, the total traffic on French inland waterways amounted to 47.78 million metric tons of merchandise, representing some 8,000 million ton-km.; this is equivalent to 830,000 ton-km. per km. of



waterway.\* This traffic consisted for the most part of heavy or bulky imperishable goods, for which railway freight charges were too high. The details of the traffic are as follows:

	Thousand metric tons
(1) Coal, coke, etc.	15,433
(2) Building materials	15,551
(3) Fertilizers	1,541
(4) Firewood	724
(5) Metals and machinery	1,246
(6) Metalliferous ores, pig and scrap iron, etc.	2,218
(7) Manufactured articles	1,807
(8) Agricultural products	5,001
(9) Mineral oils	3,711
(10) Others	544
Total	47,776

About 13½ million metric tons were classified as 'interior' or 'local' traffic, that is, passing from one point to another on the same waterway. The remaining 34 million metric tons were conveyed on longer through-journeys. Of this, over 11 million metric tons were conveyed to or from France and the three neighbouring countries of Belgium, Switzerland and Germany, while a further million metric tons passed in transit through France from one of these countries to another. This external traffic may be analysed as follows:

		Thousand metric tons
<i>Imports from</i>	Belgium	5,470
	Germany	1,707
	Switzerland	19
<i>Exports to</i>	Belgium	1,873
	Germany	1,377
	Switzerland	988
<i>Transit</i>		1,380
Total		12,814

\* The number of ton-km. is a figure obtained by multiplying the load in tons by the distance in km. It therefore gives as a rule a more accurate estimate of the 'work done' than does the absolute tonnage. This is especially so in the case of Belgium, where the absolute figure is obtained by adding together the returns of individual waterways; obviously this will be exaggerated by items of through-traffic being included several times as they pass from one waterway to another. In the case of France, however, the absolute figure is reasonably accurate, as the tonnage on each waterway is reckoned on the basis of freight loaded on that waterway and the tonnage is thus included once only. Statistics are therefore given in this text in metric tons. For comparison of various waterways, another significant figure is obtained by dividing the ton-km. by the length in km., giving ton-km. per km. of waterway. For example, this figure for Belgium is 1,820,000 ton-km. per km. of waterway; thus the Belgian waterways may be reckoned to be more than twice as active as the French waterways as a whole.

*Table of French Waterways*  
(Second-class waterways are given in italics)

Waterway	Page	Waterway	Page
North-eastern France:		48. Marne-Rhine C.	412
1. R. Aa	360	49. <i>R. Sarre</i>	413
2. Bourbourg C.	360	50. Sarre Colliery C. and branch	414
3. <i>Furnes C.</i>	361	South-eastern France:	
4. Colme C.	362	51. R. Saône	415
5. Bergues C.	362	52. Burgundy C.	418
6. Calais C.	362	53. R. Rhône	419
7. Neuf-fossé C.	363	54. <i>R. Isère</i>	423
8. Aire C.	364	55. <i>Savières C.</i>	424
9. R. Lys	365	56. <i>Arles-Bouc C.</i>	424
10. <i>Hazebrouck C.</i>	365	57. Marseilles-Rhône C.	424
11. <i>R. Lawe</i>	366	58. St Louis C.	426
12. Deule C.	366	59. Rhône-Sète C. and branches	426
13. Roubaix C.	368	60. <i>Midi C. and branches</i>	427
14. Lens C.	369	61. <i>R. Hérault</i>	429
15. R. Scarpe	369	62. <i>R. Lez</i>	429
16. Sensée C.	371	Loire Basin:	
17. R. Scheldt (Escaut) and <i>Mons-Condé C.</i>	371	63. <i>R. Loire</i>	430
18. St Quentin C.	373	64. <i>Basse-Loire C.</i>	431
19. <i>R. Somme</i>	375	65. <i>R. Mayenne-Maine</i>	432
20. Somme C.	375	66. <i>Dive C.</i>	432
Seine Basin:		67. <i>Orléans C.</i>	432
21. R. Seine	378	68. <i>Sauldre C.</i>	433
22. <i>Haute-Seine Lateral C.</i>	385	69. <i>Berry C.</i>	433
23. St Denis C.	386	70. Briare C.	434
24. St Martin C.	386	71. Loire Lateral C. and branches	434
25. <i>Ourcq C.</i>	387	72. Roanne-Digoin C.	436
26. R. Oise	387	73. <i>Nivernais C. and branch</i>	436
27. Oise Lateral C.	389	74. Centre C.	437
28. Loing C.	389	75. <i>R. Cher</i>	438
29. Oise-Aisne C.	390	North-western and Western France:	
30. R. Aisne	390	76. Caen à la Mer C.	439
31. Aisne Lateral C.	391	77. <i>Vire-et-Taute C.</i>	439
32. Ardennes C. and Vouziers branch	392	78. <i>Ille-et-Rance C.</i>	442
33. Aisne-Marne C.	393	79. Nantes-Brest C.	442
34. R. Marne	394	80. <i>Blavet C.</i>	443
35. Marne Lateral C.	395	81. <i>R. Vilaine</i>	443
36. Marne-Saône C. and Wassy branch	395	82. Luçon C.	443
37. R. Yonne	396	83. <i>Marans C.</i>	443
Eastern France:		84. <i>R. Sèvres(-Niortaise)</i>	444
38. R. Moselle	398	85. <i>Charras C.</i>	444
39. Moselle C.	399	86. R. Charente	444
40. <i>R. Chiers</i>	400	87. Charente à la Seudre C. and branch	445
41. Est C. (southern branch)	400	88. R. Garonne	446
42. Est C. (northern branch) and R. Meuse	401	89. <i>Garonne Lateral C. and branches</i>	447
43. <i>R. Semoy</i>	402	90. <i>R. Isle</i>	448
44. R. Sambre	402	91. <i>R. Dordogne</i>	448
45. Sambre-Oise C. and La Fère branch	403	92. R. Adour	448
46. R. Rhine	404		
47. Rhône-Rhine C. and branches	410		



A general survey of French waterways is set out on p. 355. For each of the ninety-two waterways, in addition to a short geographical description, details are grouped under two headings as follows:

(i) *Statistical Tables*

(a) The *Freycinet* classification is stated, that is, whether main or secondary.

(b) The total length of navigable waterway. This does not include sections classified as *flottable* and used for floating timber.

(c) The minimum depth of the waterway is stated. Where there is considerable variability of depth, as in the case of some rivers, the minimum and mean depths are both stated.

(d) The number of locks. If the dimensions of the smallest lock on the waterway conform to or exceed the dimensions laid down by the *Freycinet* Act (see pp. 350-1), a letter F is appended after the number of locks. If one or more of the dimensions are below this minimum, the figures are given. Maximum dimensions are not stated, as minimum figures control the size of canal traffic.

(e) The number of fixed bridges. If the clearance space between the maximum water level and the centre point of the arch of the lowest bridge on a waterway exceeds 3.70 m., this fact is indicated by F after the number of bridges. If the clearance is below 3.70 m., the figures are given.

(f) Tunnels. The number, length and minimum clearance of tunnels are stated.

(g) Traction. The method of haulage of barges which are not self-propelled, and the condition of the towpath are both stated. Where no method of haulage is stated, barges are almost entirely self-propelled.

(h) Tonnage. The total freight carried in 1936 is given to the nearest thousand metric tons.

(i) Traffic. The total number of barge journeys in 1936 is stated.

The figures for (h) and (i) are not available for some second-class waterways, as they are included in neighbouring first-class waterways. Where figures are given for two sections of the same waterway which have individual returns, it will be realized that a large proportion of the tonnage is the same through-traffic. Tonnage for maritime canals is not stated, as this is included in the returns of the maritime ports concerned.

(ii) *Itineraries*

An itinerary is given in tabular form under the following headings:

Ports	Km.	Wharves, factories, etc.
-------	-----	--------------------------

The more important towns served *en route* by a waterway are given in the first column; in the second the distances in kilometres from the commencement of the waterway. The name of a canal in brackets after a town indicates a junction with that canal. The third column indicates dock basins, wharf and quay facilities, boat-repairing yards, railway sidings, the main factories, collieries, quarries, mills and agricultural regions directly served by the waterway.

The total tonnage handled by each port in 1936 is stated in million metric tons in brackets after the name of the port (example: Dunkirk 1.07 M.m.t.).

## NORTH-EASTERN FRANCE

By far the most important water-transport system of France is that which serves the north-eastern coalfields, connecting them with the Dutch and Belgian industrial areas on the one hand and with the industrialized agglomeration of Paris on the other (Fig. 114).

These north-eastern canals are disposed in four groups—those of the coalfield, the coast, the water-parting and the Somme.

*The Coalfield canals* form a connecting system linking the navigable Lys, Scarpe and Scheldt (Escaut) rivers, and serving both the coalfields and the great industrial complex of Lille-Roubaix lying a little to the north. Béthune, Harnes-Auby and Douai are the chief colliery ports; the first distributes from the western coalfield towards Lille, Paris and even Lyons, while Douai, the biggest coal-storage depot in France, and Auby send coal from around Lens to the same markets. Other bulky industrial commodities include coke, iron ore, salt, soda, wood-pulp, wool and lime.

*The Coast canals* serve the coastal strip and the ports of Calais, Gravelines and Dunkirk (Fig. 115). As these canals are linked to the coalfield, they have been responsible for the establishment in recent years of industries dependent on canal-borne coal and sea-borne raw



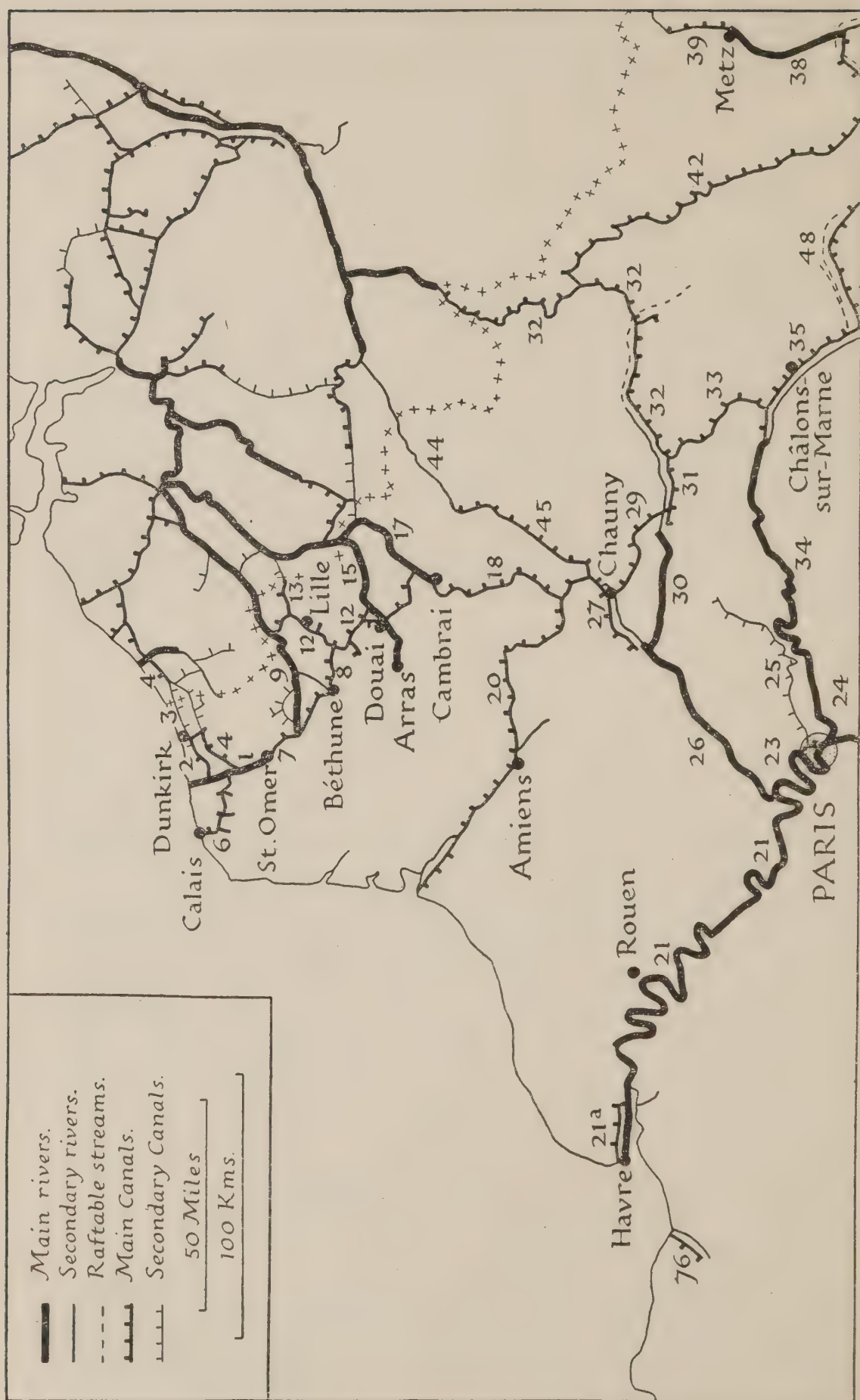


Fig. 114. The waterways of north-eastern France

The classification of waterways on this and succeeding figs. conforms to the official *Freycinet* standard. The numbers refer to the table on p. 355. The waterways of the departments of Nord and Pas-de-Calais are shown on Fig. 115 on an enlarged scale.

materials. The hinterland of these northern ports includes, besides the coalfields, the rich lands of the Aa basin which produce a large surplus of wheat, sugar beet, dairy produce and vegetables for coast-wise or cross-Channel distribution. Large quantities of sugar beet and beet pulp are sent to local mills and refineries by water, and the sugar is, for the most part, distributed in the same way. In addition, much farm manure, artificial fertilizer, marl, lime, cattle cake, fodder and grain travel locally by water.

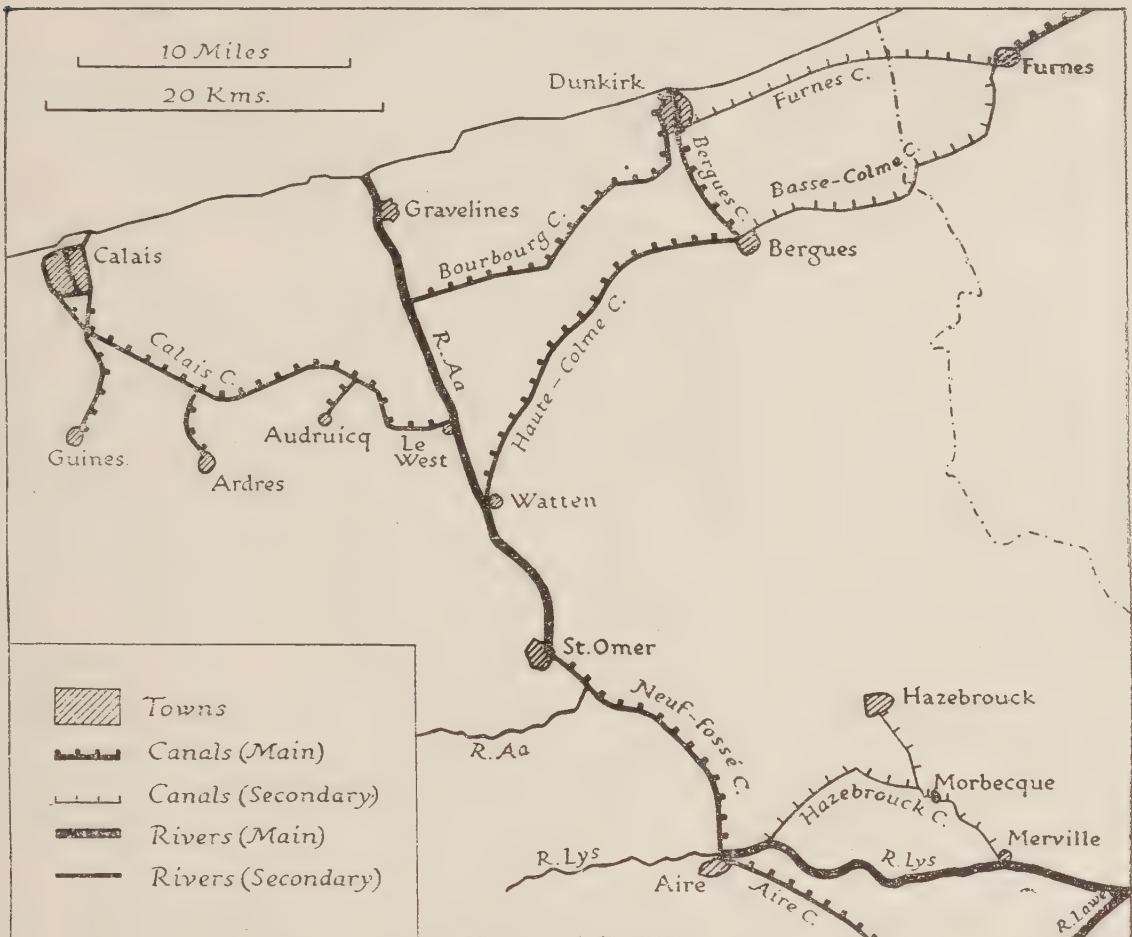


Fig. 115. The waterways of northern France

*The Water-divide canals.* The negotiation of locks and tunnels through the gaps in the Picardy-Artois chalk watershed slows down traffic very considerably. Since the war of 1914-18 much money has been spent on the improvement of the St Quentin Canal, particularly where tunnels are necessary under the chalk ridge; the provision of electric traction has been a notable feature. As a result, the carrying capacity of the canal has been doubled and a pre-1914 project for the construction of a Nord Canal to connect Douai with the river Oise has been dropped (page 374).



*The Somme Canal.* The Somme and its lateral canal are somewhat isolated, but serve to bring Amiens into contact with the St Quentin Canal.

### *Details of the North-eastern Waterways*

#### 1. *River Aa*

(a) Freycinet classification	Main
(b) Length	29 km.
(c) Depth	2.20 km. (min.) to 2.50 m. (mean)
(d) Locks	1 double (F)
(e) Fixed bridges	3 (F)
(f) Tunnels	None
(g) Traction	Tractor from Bourbourg Canal junction; horse above. Metalled towpath
(h) Tonnage (1936)	Included in return of Bourbourg Canal
(i) Barge journeys (1936)	Included in return of Bourbourg Canal

The Aa emerges from the chalk plateau of Artois near St Omer, from which point it is canalized, and flows to Watten through a richly cultivated polderland surrounded by sandy hills. From Watten the river makes its way towards the coastal dunes across a plain which in the eighteenth century was an extensive marsh but which is now a maze of drainage channels.

Gravelines, although but a small fishing centre, is a river port of some little importance, handling traffic between St Omer, the Béthune colliery district and the coastal industries. Its industries include saw mills and paper and metallurgical industries; for these, the inland waterways bring coal, wood-pulp, pig-iron, timber, salt, and fertilizers. By sea, it exports small quantities of the agricultural produce of its hinterland.

Ports	Km.	Wharves, factories, etc.
Estuary	0	
Gravelines	1	Fishing port (p. 84). Saw and paper mills
Bourbourg-Campagne (Bourbourg C.)	6	Wharves serving distilleries and chicory mills
Watten (Colme C.)	16	Agricultural area
St Omer (Neuf-fossé C.)	29	Wharves serving small market town. Lingerie manufacture

#### 2. *Bourbourg Canal*

(a) Freycinet classification	Main
(b) Length	21 km.
(c) Depth	2.00 m.
(d) Locks	3 (F)

(e) Fixed bridges	11 (F)
(f) Tunnels	None
(g) Traction	Tractor. Metalled towpath
(h) Tonnage (1936)	(Including R. Aa) 2,045,000
(i) Barge journeys (1936)	(Including R. Aa) 11,001

This canal links the Aa to the barge port of Ile de Jeanty at Dunkirk (Figs. 4, 5 and Plates 1, 84). Bourbourg receives large quantities of coal for its distilleries and chicory mills; it is a market town and exports farm and dairy produce to the industrial district round Lille, and to England via Dunkirk. In 1936 approximately three-quarters of a million metric tons of coal and the same weight of agricultural products were conveyed on the canal.

Dunkirk, at the junction of three canals, is the ninth inland port of France and handled just over a million tons of canal traffic in 1936.

Ports	Km.	Wharves, factories, etc.
Bourbourg (R. Aa)	0	Wharves serving distilleries and chicory mills
Coudekerque	19	2 km. of railway sidings linked to Nord by special lines. Private quays owned by oil and soap factories
Cappelle (0.13 M.m.t.)	20	
Dunkirk (1.07 M.m.t.) (Bergues C., Furnes C.)	21	See pp. 11-22

### 3. *Furnes Canal*

(a) Freycinet classification	Secondary
(b) Length	21.50 km. (13 km. in France)
(c) Depth	1.80 m.
(d) Locks	1 (F)
(e) Fixed bridges	10 (3.60 m.)
(f) Tunnels	None
(g) Traction	Tractor. Metalled towpath
(h) Tonnage (1936)	259,000
(i) Barge journeys (1936)	1,206

This canal links Dunkirk and the French coastal waterways with Furnes, Nieuport and, via the Belgian system, with Bruges, Ghent and Antwerp. The *péniche* can use the canal under good conditions, but the supply of water is not always satisfactory and traffic is greatly impeded in an unusually dry summer. The tonnage rarely exceeds a quarter of a million metric tons per annum, and consists chiefly of coal, bricks and agricultural produce.



4. *Colme Canal*

(a) Freycinet classification	Haute-Colme main; Traversé de Bergues and Basse-Colme secondary
(b) Length	36 km. in France, 11 km. in Belgium
(c) Depth	Haute-Colme 2.00 m.; Basse-Colme 1.06 m.
(d) Locks	4 (F)
(e) Fixed bridges	(i) Haute-Colme, 3 (F) (ii) Traversé de Bergues, 5 (2.37 m.) (iii) Basse-Colme, 6 (2.70 m.)
(f) Tunnels	None
(g) Traction	Tractor and horse on Haute-Colme; man haulage on Basse-Colme. Metalled towpath to Bergues; paved above Bergues
(h) Tonnage (1936)	50,000
(i) Barge journeys (1936)	466

The canal leaves the Aa 13 km. below St Omer and passes to Furnes in Belgium, where it joins the Furnes Canal. The section of 12 km. through Bergues and on to the Belgian frontier has a depth of only 1.06 m., and there is little traffic beyond the town.

*Hondschoote Branch.* A short branch 2 km. in length links the main canal with Hondschoote.

5. *Bergues Canal*

(a) Freycinet classification	Main
(b) Length	8 km.
(c) Depth	2.50 m.
(d) Locks	None
(e) Fixed bridges	7 (F)
(f) Tunnels	None
(g) Traction	Horse and tractor. Metalled towpath
(h) Tonnage (1936)	389,000
(i) Barge journeys (1936)	2,295

This short stretch of canal forms a transverse connexion between the two parallel coastal systems. Agricultural produce comprises nearly one-half of the total freight.

Ports	Km.	Wharves, factories, etc.
Bergues (Colme C.)	0	Wharves
Dunkirk (1.07 M.m.t.) (Bourbourg C., Furnes C.)	8	See pp. 11-22

6. *Calais Canal*

(a) Freycinet classification	Main
(b) Length	30 km.
(c) Depth	2.00 m.
(d) Locks	1 (F)

(e) Fixed bridges	14 (F) (N.B. Four-branched bridge at Pont-sans-Pareil limits barge length to 28 m.)
(f) Tunnels	None
(g) Traction	Horse. Metalled towpath
(h) Tonnage (1936)	570,000
(i) Barge journeys (1936)	2,959

The canal links the Aa with the Bassin Carnot and Bassin de l'Ouest of the maritime port of Calais (Fig. 6).

About half a million metric tons of goods, equivalent to some 40 % of the total trade of Calais, are conveyed annually by canal.

Ports	Km.	Wharves, factories, etc.
Ruminghem (R. Aa)	0	Wharves
Le Rebus (Audruicq B.)	8	
Pont-sans-Pareil (Ardres B.)	18	Wharves serving sugar mills
Coulogne (Guines B.)	25	
Calais (0.15 M.m.t.)	30	See pp. 23-8
(Pont Mollien, maritime port)		

### *Branches of the Calais Canal*

Three short branches join the main canal to the small towns of Audruicq, Ardres and Guines which are situated a few kilometres to the south.

	(i) Audruicq branch (Le Rebus to Audruicq)	(ii) Ardres branch (Pont-sans-Pareil to Ardres)	(iii) Guines branch (Coulogne to Guines)
(a) Freycinet classification	Main	Main	Main
(b) Length	2 km.	5 km.	6 km.
(c) Depth	2.00 m.	2.00 m.	1.70 m.
(d) Locks	None	None	None
(e) Fixed bridges	1 (3.33 m.)	2 (3.30 m.)	4 (F)
(f) Tunnels	None	None	None
(g) Traction	Horse. Metalled towpath	Horse. Metalled towpath	Horse. Metalled towpath
(h) Tonnage (1936)	Tonnage included in return of main canal	Tonnage included in return of main canal	Tonnage included in return of main canal
(i) Barge journeys (1936)	Tonnage included in return of main canal	Tonnage included in return of main canal	Tonnage included in return of main canal

### *7. Neuf-fossé Canal*

(a) Freycinet classification	Main
(b) Length	18 km.
(c) Depth	2.00 m.
(d) Locks	2 (width 5.13 m., other dimensions F)
(e) Fixed bridges	8 (F)
(f) Tunnels	None
(g) Traction	Compulsory electric haulage. Capstan and windlass at Les Fontinettes staircase
(h) Tonnage (1936)	2,172,000
(i) Barge journeys (1936)	9,859



This canal links the Aa and the coastal canals with the Lys and the industrial area of the coalfield; it carries annually over a million metric tons of agricultural produce, mostly towards the sea.

Ports	Km.	Wharves, factories, etc.
St Omer (canalized R. Aa)	0	Wharves. Railway junction
Arques (0·13 M.m.t.) (Les Fontinettes)	5	Staircase of five locks with hydraulic lift. Wharves serving jute factories and glass works
Aire (Aire C., R. Lys)	18	Wharves

### 8. *Aire Canal*

(a) Freycinet classification	Main
(b) Length	41 km.
(c) Depth	2·60 m.
(d) Locks	1 double (F) at Guinchy
(e) Fixed bridges	32 (3·62 m.)
(f) Tunnels	None
(g) Traction	Electric tractor. Metalled towpath
(h) Tonnage (1936)	3,326,000
(i) Barge journeys (1936)	13,425

This canal, together with the Deule, forms the chief water route of the coalfields of the Nord and Pas-de-Calais departments, and conveys over two million metric tons of coal per annum. Béthune, the sixth greatest inland port in France, in 1936 handled 1,318,000 metric tons, of which over a million were embarked.

Ports	Km.	Wharves, factories, etc.
Aire (Neuf-fossé C., R. Lys)	0	See (7)
Isbergues (0·17 M.m.t.)	5	Colliery and industrial port serving Ligny and Ferfay mines. Blast furnaces. Basin for 30 barges
Annezin (by-pass branch)	21	Coal wharves serving Marles mines
Béthune (1·32 M.m.t.)	23	Railway control centre. Converging routes. Public port serving chemical factories and general industries
(By-pass branch)	26	
Beuvry (0·59 M.m.t.) (Beuvry branch)	27	Wharves, basin for 60 barges
Violaines (0·45 M.m.t.)	32	Wharves
Bauvin (Deule C.)	41	

### *Branches of the Aire Canal*

(i) A stretch of 4 km. from Beuvry to Annezin allows through traffic to by-pass Béthune. (ii) A branch canal 3 km. long (the Nœux or Beuvry branch) links the main canal with the industrial suburbs of Beuvry.



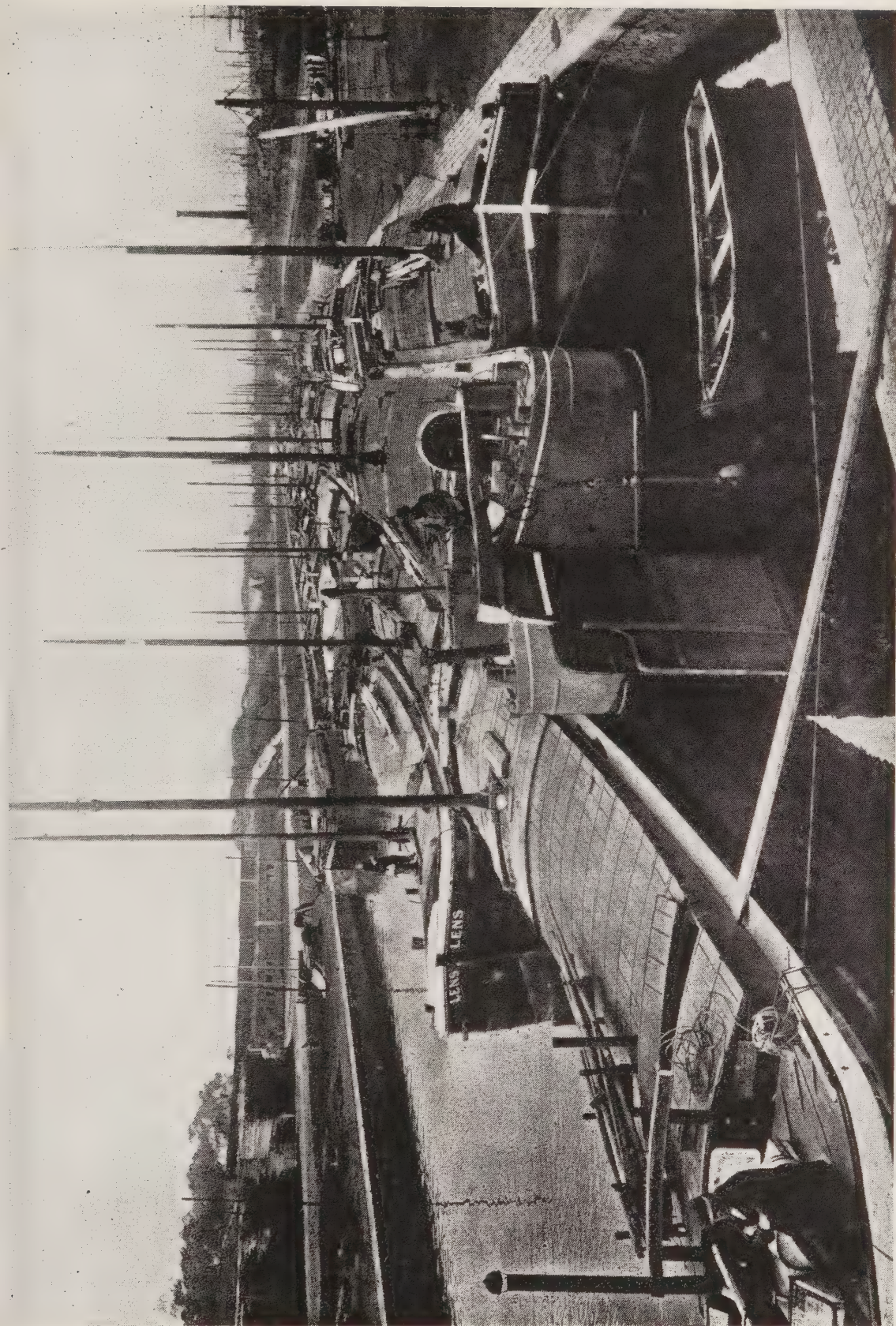


Plate 84. Jeanty Island Canal, Dunkirk

This canal acts as a junction between the inland waterways (Furnes, Bergues and Bourbourg Canals) and the maritime port; masts of ships may be seen in the distance on the right. (See also Plate 1.)



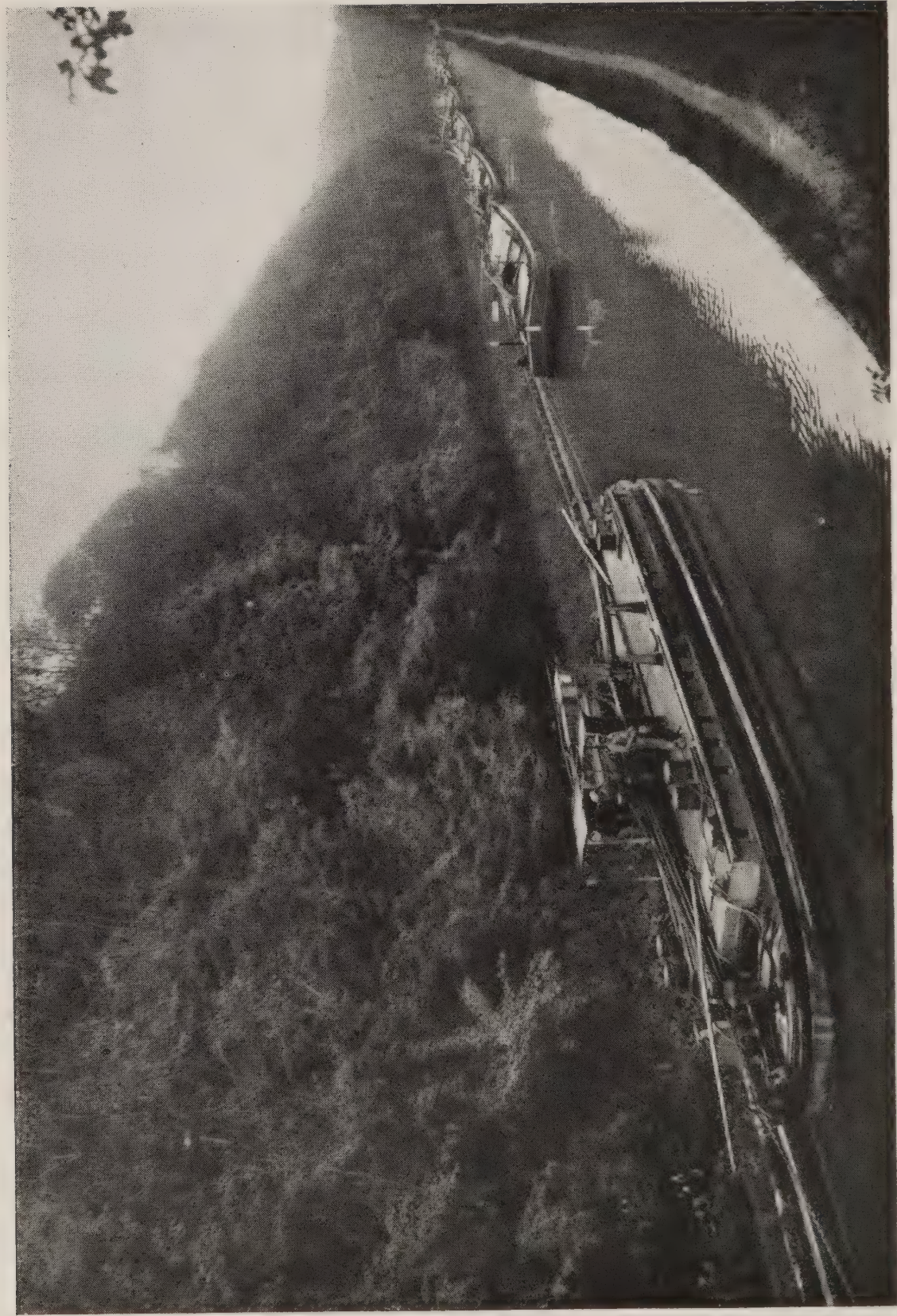


Plate 85. St Quentin Canal

The Artois divide is crossed by two tunnels; the barges are moving through a cutting on the St Quentin side of the Riqueval tunnel (6676 m. long). They are propelled by a sunken chain worked by an electric capstan.



9. *River Lys*

(a) Freycinet classification	Main
(b) Length	72 km.
(c) Depth	2.00 m.
(d) Locks	6 (width 5.17 m., other dimensions F)
(e) Fixed bridges	25 (3.30 m.)
(f) Tunnels	None
(g) Traction	Tractor, horse and man-power. Metalled towpath
(h) Tonnage (1936)	773,000
(i) Barge journeys (1936)	3,394

The river runs from Aire across the Belgian frontier (which follows it for 25 km.) to the Scheldt confluence at Ghent. It is navigable for the *péniche*, but a vessel drawing more than 1.50 m. cannot berth at some quays, which means that the maximum tonnage is effectively reduced to 200. In 1936, almost one-half of the total cargo consisted of coal.

Ports	Km.	Wharves, factories, etc.
Aire (Neuf-fossé C., Aire C.)	0	See (7)
Thiennes (Hazebrouck C.)	5	Wharves
Merville (Hazebrouck C.)	19	Wharves
La Gorgue (R. Lawe confluence)	25	Wharves
Armentières	44	Wharves serving textile mills
Deulemont (Deule C.)	53	
Comines (0.12 M.m.t.)	61	Wharves
Menin (Belgian frontier)	72	

10. *Hazebrouck Canals*

These canals consist of three short stretches which form a double connexion between Hazebrouck and the Lys at Thiennes and Merville.

	Section (i) Hazebrouck C.	Section (ii) Préaven C. (through Morbecque) and the canalized Bourre
(a) Freycinet classification	Secondary	Secondary
(b) Length	6 km.	10 km.
(c) Depth	1.30 m.	1.30 m.
(d) Locks	None	4 (F but depth 1.30 m.)
(e) Fixed bridges	19 (including (ii) and (iii)) (2.75 m.)	19 (including (i) and (iii)) (3.87 m.)
(f) Tunnels	None	None
(g) Traction	Man power and horse	Man power and horse
(h) Tonnage (1936)	Including (ii) and (iii) 15,000	Included in section (i)
(i) Barge journeys (1936)	Including (ii) and (iii) 133	Included in section (i)



## Section (iii) Nieppe C.

(a) Freycinet classification	Secondary
(b) Length	9 km.
(c) Depth	1.30 m.
(d) Locks	1 (F but depth 1.30 m.)
(e) Fixed bridges	19 (including (i) and (ii)) (2.70 m.)
(f) Tunnels	None
(g) Traction	Man power and horse
(h) Tonnage (1936)	Included in section (i)
(i) Barge journeys (1936)	Included in section (i)

These are classified as secondary canals, for the depths are considerably below normal; the maximum dimensions of craft allowed to navigate them therefore are 27 m. by 3.40 m. with 1.10 m. draught, with a tonnage of 90 only. The freight conveyed is consequently small in amount.

11. *River Lawe*

(a) Freycinet classification	Secondary
(b) Length	18 km. + 1,358 m. linking it with Aire C.
(c) Depth	1.40 m.
(d) Locks	5 (36.00 m. by 5.05 m. by 1.40 m.)
(e) Fixed bridges	12 (F but 2.60 m. in flood)
(f) Tunnels	None
(g) Traction	Horse. Towpath metalled for 9 km.
(h) Tonnage (1936)	700
(i) Barge journeys (1936)	7

The Lawe flows through Béthune to join the Lys at La Gorgue. Its navigation is prolonged by a stretch of 1358 m. which links it with the Aire Canal. It is not very important, as its minimum depth is 1.40 m. In 1936 it conveyed merely 700 metric tons of coal.

12. *Deule Canal*

(a) Freycinet classification	Main
(b) Length	63 km.
(c) Depth	(i) Deulemont to Marquette, 2.20 m. (ii) Marquette to Bauvin, 2.60 m. (iii) Bauvin to Flers-en-Escrebieux, 2.50 m.
(d) Locks	8 (F)
(e) Fixed bridges	50 (F)
(f) Tunnels	None
(g) Traction	Electric tractor. Metalled towpath
(h) Tonnage (1936)	7,998,000
(i) Barge journeys (1936)	12,192

This is one of the most important colliery canals of French Flanders, as it links the Lys and Scarpe systems and passes through Lille. It thus not only serves the Lille-Roubaix industrial complex but provides connexion with the coast, particularly at Dunkirk, with Paris via the Sensée and St Quentin Canals, and with Belgium. Although the canal is navigable for the *péniche*, works have been started to bring the minimum depth up to 2.50 m., so enabling larger craft to be used; these had not been completed by 1937.

The canal is remarkable for a succession of coal and industrial wharves. Lille, the great centre of this industrial area, in 1936 handled 364,000 metric tons of water-borne freight. Coal ( $4\frac{1}{2}$  million metric tons in 1936), pit-props and pyrites pass into or through the canal zone from Belgium, salt and soda from Lorraine, and wool from Dunkirk.

Ports	Km.	Wharves, factories, etc.
Deulemont (R. Lys)	0	Wharves
Quesnay	6	Dock basin for 60 barges
Marquette (0.22 M.m.t.) (Roubaix C.)	12	Wharves
St André	15	Dunkirk branch of Nord Railway
La Madeleine (0.22 M.m.t.)	15	Portion of old canal bed branches and forms Port of Basse-Deule. Great industrial area of Lille begins
Lille (0.36 M.m.t.)	15-19	Port Vauban, Port du Grand Tour- nant
Loos (0.26 M.m.t.)	21	
Haubourdin (0.18 M.m.t.)	24	
Wavrin (branch)	29	
Annœullin	33	Wharves
Meurchin (0.26 M.m.t.)	34	
Bauvin (Aire C.)	37	Public wharves. Private dock owned by sugar refinery
Wingles	40	Dock to hold 150 barges
Pont-à-Vendin	41	Dock basin for 120 barges and barge- building yards. Cement works
Vendin-le-Vieil (0.41 M.m.t.)	42	Private port of Lens Mining Co. Nord railways sidings. Plaster of Paris works
Annay	44	Public wharves. Sidings linked to Lens-Armentières branch of Nord Railway
Estevelles	45	Boat-building yards. Basin to hold 120 empty barges
Harnes	46	Coal wharves
Courrières (Lens C.)	47	Coal wharves. Private wharves of Courrières Mining Co. Distillery and refinery wharves. Timber port handling pit-props
Oignies (0.26 M.m.t.)	49	Public wharves serving distilleries. Private wharves of Ostricourt Min- ing Co. Connexions with Nord Railway
Dourges	53	Public wharves. Private colliery wharves
Noyelles-Godault (0.22 M.m.t.)	54	Coal wharves of Dourges Colliery Co.
Courcelles-lez-Lens	56	Basin to accommodate 200 barges
Auby (0.36 M.m.t.)	58	2 km. of wharves belonging to Cie Royale Asturienne des Mines. Wharves serving chemical factories, lime-kilns, metallurgical factories, coke ovens and blast furnaces. Pri- vate sidings and wharves of Lorraine Carbonis Co. Nord railway sidings
Flers-en-Escrebieux	61	Basin for 50 barges. Private port of Cie des Mines de l'Escarpelle
Escarpelle (0.25 M.m.t.)	62	
Fort de Scarpe (Scarpe confluence)	63	



*Seclin Branch of the Deule Canal*

A short branch, 5 km. in length, runs from Wavrin on the main canal to Seclin. The tonnage conveyed is included in the return of the main canal.

*13. Roubaix Canal*

(a) Freycinet classification	Main
(b) Length	20 km. in France, 8 km. in Belgium
(c) Depth	2.00 m.
(d) Locks	13 (width 5.13 m.)
(e) Fixed bridges	38 (F)
(f) Tunnels	None
(g) Traction	Horse and electric tractor. Paved towpath
(h) Tonnage (1936)	945,000
(i) Barge journeys (1936)	3,883

This leaves the Deule Canal at Marquette, and continues to the Belgian frontier. It connects the Deule coalfield with the Scheldt navigation in Belgium. It has two side canals, each 2 km. long, serving the textile centres of Croix and Tourcoing. While coal is the heaviest cargo (382,000 metric tons in 1936), wool comes via Dunkirk and salt and soda from Lorraine.

Ports	Km.	Wharves, factories, etc.
Marquette (Deule C.)	0	Wharves serving Deule coalfield district
Wasquehal (Croix B.)	8	Wharves handling salt from Varrangeville for chemical works. (Branches serve textile areas)
Roubaix (Tourcoing B.)	13	Coal wharves belonging to Nœux Mining Co. Other wharves serving chemical works
Leers	19	
(Belgian frontier)	20	

*Roubaix Branch Canals*

Two short branches link the main canal with the industrial towns of Croix and Tourcoing.

	(i) Croix branch	(ii) Tourcoing branch
(a) Freycinet classification	Main	Main
(b) Length	2 km.	2 km.
(c) Depth	2.00 m.	2.00 m.
(d) Locks	1 (F)	None
(e) Fixed bridges	2 (F)	None
(f) Tunnels	None	None
(g) Traction	Electric tractor. Metalled towpath	Electric tractor. Metalled towpath
(h) Tonnage (1936)	Included in return of main canal	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal	Included in return of main canal

14. *Lens Canal (or Souchez Canal)*

(a) Freycinet classification	Main
(b) Length	11 km.
(c) Depth	2.20 m.
(d) Locks	3 (F)
(e) Fixed bridges	15 (F)
(f) Tunnels	None
(g) Traction	Electrically and petrol driven tractors. Metalled towpath
(h) Tonnage (1936)	890,000
(i) Barge journeys (1936)	3,331

This is a cul-de-sac fed by the Souchez. It joins the Lens section of the Pas-de-Calais coalfield to the Deule Canal, and is bordered by almost continuous coal wharves. Of the total tonnage conveyed in 1936, over seven-eighths was coal.

Ports	Km.	Wharves, factories, etc.
Courrières (Deule C.)	0	See (12). Rail connexion with Nord Railway. Wharves of Carvin Mining Co.
Harnes (0.54 M.m.t.)	3	Distribution port for Lens coalfield. Sidings on Nord Rly. Public wharves. Private wharves of Cie des Mines de Courrières
Lens	9	Marshalling basin. Public wharves. Private wharves of Mines de Liévin
Eleu (0.32 M.m.t.)	11	Public wharves. Private wharves owned by Cie des Mines de Liévin. Nord Railway connexions

15. *River Scarpe*

The Scarpe system includes upper and lower sections of canalized river, separated by a derivation canal round Douai.

	(i) Upper Scarpe	(ii) Douai Derivation Canal	(iii) Lower Scarpe
(a) Freycinet classification	Main	Main	Main
(b) Length	23 km.	7 km. and 800 m. connexion between Deule C. and R. Scarpe	36 km.
(c) Depth	2.20 m.	2.50 m.	2.20 m.
(d) Locks	9 (F)	3 (F × 5.18 × 1.80 m.)	6 (38.7 × 5.11 m. × F)
(e) Fixed bridges	12 (3.32 m.)	10 (F)	10 (F)
(f) Tunnels	None	None	None
(g) Traction	Horse or tractor. Metalled towpath	Horse. Metalled towpath	Tractor. Metalled towpath
(h) Tonnage (1936)	780,000	Included in return of Sensée C.	2,047,000
(i) Barge journeys (1936)	2,989	Included in return of Sensée C.	7,877



This tributary of the Scheldt joins the main river beyond the Belgian frontier. The upper Scarpe is canalized from Arras. Traffic has been suspended since 1926 on a short section through Douai, round which flows a derivation loop of the river; this is connected to the Middle Scarpe below the town by a canal 800 m. long. Thus Douai has a double river frontage of great value. The loop is also joined by the Sensée and Deule Canals. The Scarpe joins the Scheldt at Mortagne about 1 km. from the frontier. By far the greater volume of traffic is on the Lower Scarpe below Douai; over half the tonnage of 1936 was coal.

## Sections (i) and (iii)

Ports	Km.	Wharves, factories, etc.
Arras	0	Railway centre. Public wharves serving agricultural machinery factories, oil and sugar refineries and distilleries. Private wharves belonging to Bully-Grenay Electricity Co.
Blache	14	Railway sidings, wharves serving foundries and rolling mills, and cement works
Vitry	17	Private wharves of wire drawing works
Brébières	19	Private wharves of chemical and wood impregnation works
Corbehem - Courchelette (derivation branch round Douai. Sensée C.)	23-24	Boat-building yards. Private and public wharves serving oil mills and petrol refinery
Douai (0.9 M.m.t.) (between Pont des Dominicains and Pont d'Alsace river is closed—replaced by deri- vation branch)	28-30	Great coal-storage accommodation. Chief coal depot of north-east France. Public and private wharves serving metallurgical works and miscellaneous industries. Derivation branch and several basins
Fort de Scarpe (Deule C.)	30	Continuous industrial area Flines-lez-Raches Colliery wharves. Railway sidings
Flines-lez-Raches	31-37 38	
Wandignies-Hamage	48	Private wharves serving pottery works
Hasnon	54	Private wharves serving distillery
St Amand-les-Eaux	58	Public and private wharves serving zinc works, forges, rolling mills
Thun	65	Boat-building yards. Private wharves belonging to Nord Railway Co.
Mortagne-du-Nord	65	Boat-building yards serving saw-mills and railway sidings. Zinc works. Private and public wharves
Scheldt confluence (1 km. from Belgian frontier)	66	

## Section (ii). Douai Derivation Canal

Ports	Km.	Wharves, factories, etc.
Corbehem (R. Scarpe and Sensée C.)	0	
Courchelette	1	Private wharves serving oil refinery
Sambres	2	Boat-building yards
	3	Basin for 250 barges. Public wharves
Douai	to	
	5	Private wharves serving metal-lurgical factories
Flers-en-Escrebieux (Deule C.)	8	Boat-building yards
Junction with Lower Scarpe	8	

16. *Sensée Canal*

(a) Freycinet classification	Main
(b) Length	25 km.
(c) Depth	2.50 m.
(d) Locks	1 double (F)
(e) Fixed bridges	14 (F)
(f) Tunnels	None
(g) Traction	Electric traction on rails. Paved towpath
(h) Tonnage (1936)	(Including Douai Derivation C.) 5,305,000
(i) Barge journeys (1936)	(Including Douai Derivation C.) 20,530

The canal runs from Corbehem-Courchelette on the Scarpe above Douai to the Bassin Rond near Etrun on the Scheldt. Its coal traffic is very heavy (3,172,000 metric tons in 1936), as it forms the main connexion between the coalfield canals and Paris via the St Quentin Canal.

Ports	Km.	Wharves, factories, etc.
Corbehem-Courchelette (R. Scarpe)	0	See R. Scarpe (15)
Férin	3	Wharves. Basin for 20 barges
Arleux-du-Nord	7	Dock basin at Nord Railway junction. Wharves serving Arleux sand quarries and brick works
Aubigny-au-Bac	13	Boat-building yards. Basin for 16 barges. Public wharves
Etrun	24	Coal port. Basin for 300 barges. Public wharves
Bassin Rond (R. Scheldt)	25	Boat-building yards

17. *River Scheldt (Escaut)*

(a) Freycinet classification	Main
(b) Length	63 km. + 25 km. of locked derivations
(c) Depth	Cambrai to Condé, 2.40 m.; Condé to frontier, 2.20 m.
(d) Locks	16 (width 5.10 m., other dimensions F)
(e) Fixed bridges	14 (3.62 m.)
(f) Tunnels	None
(g) Traction	Electric tractor. Metalled towpath
(h) Tonnage (1936)	10,461,000
(i) Barge journeys (1936)	34,312



The river is canalized from Cambrai where the St Quentin Canal begins. Between Cambrai and Etrun the Scheldt serves the rich agricultural district of Cambrésis with its cereals and sugar beet, its sugar refineries and its varied textile industry. At Bouchain the river enters the eastern portion of the French coalfield through which it runs to Condé, whence it turns north-east towards the textile district of Tournai and so across the frontier at Mortagne into Belgium. The almost continuous line of collieries and industrial establishments along its banks are equipped with wharves and warehouses, most of them connected with local railways. As a result, in all France only the river Seine and the St Quentin Canal have a greater tonnage per annum, and of the total in 1936 of over 10 millions (which means about 3 millions on each section) more than half was coal.

Ports	Km.	Wharves, factories, etc.
Cambrai (0.25 M.m.t.) (St Quentin C.)	0	Dock basins and warehouses serving timber yards and textile factories. Nord Railway at Selles (1 km.). Boat-building yards
St Roch	2	Wharves serving bleaching and dyeing factories
Erre-en-Ostrevent	3	Dock belonging to large sugar refineries. Connexion with Nord Railway. Boat-building yards
Escaudœuvres	4	Public wharves with enclosed basin
Bassin Rond	12	Boat-building yards. Enters east part of French coalfield
Bouchain	16	Public wharves importing salt and soda. Chemical and chicory factory
Neuville	19	Boat-building yards. Public and private wharves serving sugar mills, distillery and saw-mills
Lourches	21	Coal wharves of Douchy mines. Connexion with Busigny-Somain Railway. Private wharves of phosphate factory
Denain (0.94 M.m.t.)	22	Boat-building yards. Private wharves serving mills, brick works, sugar refineries and glass works
L'Enclos	24	Private wharves of Anzin collieries
Thonville	25	Public wharves of wine depot, gas-works and saw mills
Prouvy (0.11 M.m.t.)	28	Private wharves of paper mills and malt houses. Boat-building yards
Trith-St Léger	31	Private wharves of nail factory and iron and steel works. Railway sidings
Valenciennes (0.21 M.m.t.)	32-37	All works have river frontages with numerous private and public wharves serving metallurgical works, earthenware works, malt houses, coal and sand depots, saw-mills, gas works, electricity works, lime kilns, sugar refineries, textile factories, phosphate mills and chemical works

Anzin	38	Coal centre. Wharves with railway sidings serving Scheldt and Meuse tube factories, glucose factory, blast furnaces and forges of Denain and Anzin Colliery Co.
Bruay-en-Artois	41	Colliery wharves
Thiers-la-Grange	43	Private wharves of Anzin collieries
Escaupont	44	Private wharves of glass works
Fresnes (0.10 M.m.t.)	46	Wharves and sidings on St Amand Railway serving glass works, breweries, sugar mills, malthouses, chicory mills and timber yards
Condé (Mons- Condé C.)	48	Wharves linked to Somain-Peruwelz Railway serving Anzin Colliery Co. and metallurgical works
Hergnies	53	Wharves of St Amand-Bland-Misseron. End of Anzin coalfield
Rodignies	59	Wharves serving textile district. Corset and ribbon factories
Mortagne-du-Nord (R. Scarpe)	62	Customs port
Belgian frontier	63	

### 17a. Mons-Condé Canal

(a) Freycinet classification	Secondary
(b) Length	5 + 20 km. in Belgium
(c) Depth	2.00 m.
(d) Locks	2 (width 5.16 m.), 5 in Belgium
(e) Fixed bridges	1 (F), 2 in Belgium
(f) Tunnels	None
(g) Traction	Horse and tractor. Metalled towpath
(h) Tonnage (1936)	742,000
(i) Barge journeys (1936)	2,739

This canal is the end of a chain of waterways that brings the Belgian coalfields into touch with Paris. Coal comprises more than one-half its total tonnage.

### 18. St Quentin Canal

(a) Freycinet classification	Main
(b) Length	93 km.
(c) Depth	2.30 m.
(d) Locks	35 double (F)
(e) Fixed bridges	44 (F) + 1 (3.68 m.)
(f) Tunnels	Two: (i) 6676 m. } $\times 5.90 \times 4.20$ m. clearance (ii) 1098 m. }
(g) Traction	Electric traction obligatory except for motor barges. Electric tractor. Sunken chain across divide, towage compulsory. Metalled towpath
(h) Tonnage (1936)	7,400,000
(i) Barge journeys (1936)	28,463

This very important canal crosses the watershed between Cambrai on the Scheldt and Chauny on the Oise Lateral Canal. With its continuations the canal forms a most vital link between the waterways of the northern industrial region and the rest of France. This through-route has a greater volume of traffic than any other French



waterway, with the exception of the lower Seine. Its annual traffic is between 7 and 8 million metric tons, two-thirds of which, almost all coal, originate in the north-east and move towards Paris. Efforts have been made to accelerate traffic. Electric traction has been in general use since 1926, and there are 360 tractors operating on rails. A sunken chain is worked by electric capstans across the divide (Plate 85) except at Pont-Vendhuile where tractors are used. Here, the towage service must be employed even for boats moving under their own power. It has been estimated that, with a yearly average of 340 working days of 16 hr., electrical haulage has increased the annual capacity of the canal from 36,000 to 60,000 barges, although the number actually using it is far below that figure. The Artois divide is crossed in two tunnels which still form a bad bottle-neck, although they have been deepened and widened. Unlike the coal-field canals, it has but little industrial development along its banks, with the exception of Chauny, where the convergence of waterways has been a factor in the development of considerable industries.

The Nord Canal was planned to relieve congestion on the St Quentin Canal by providing another route from the northern industrial region to the Paris basin. It was begun in 1907 and by 1914 32 km. had been completed and the same distance was under construction; the planned total length was nearly 100 km. The completed section was destroyed during 1914-18, and was afterwards left derelict. A scheme was put forward in 1933 to complete the canal on a less ambitious scale (i.e. to take 300-ton barges instead of 600-ton), but was rejected. In 1938 a committee recommended its completion on the original scale at a cost of 500 million fr., but no action has been taken.

Ports	Km.	Wharves, factories, etc.
Cambrai (0.25 M.m.t.) (R. Scheldt)	0	See (17)
Marcoing	8	Private colliery wharves
Masnières	11	Private wharves serving sugar refineries and textile mills
La Grenouillère	19	Wharves serving sugar refineries. Basin for 30 barges
Bony	29	Riqueval tunnel entrance
Bellicourt	35	Tunnel exit
Le Tronquoy	42	Tunnel 1098 m.
Omissy	47	Private wharves serving sugar refinery
Rouvray	49	Private wharves serving brick works
St Quentin (0.19 M.m.t.)	52-54	Public and private wharves serving distillery, brick works and oil refinery
Tergnier	84	Private wharves serving sugar refinery, blast furnaces and foundry

Fargniers (Sambre-Oise C.)	85	Public wharves
Chauny (0·14 M.m.t.) (Oise Lateral C.)	91-93	Boat-building yards. Public and private wharves serving blast furnaces, engineering works, chemical and glass works

### 19. *River Somme*

(a) Freycinet classification	Secondary
(b) Length	Short local stretches totalling 4 km. from Amiens to St Simon
(c) Depth	Variable (below 2·00 m.)
(d) Locks	None
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Horse. Unpaved towpath
(h) Tonnage (1936)	Included in return of Somme C
(i) Barge journeys (1936)	Included in return of Somme C

Only a few short stretches of the Somme are used for navigation, and these carry mainly sugar beet.

### 20. *Somme Canal*

(a) Freycinet classification	Main
(b) Length	156 km.
(c) Depth	2·00 m.
(d) Locks	25 (F)
(e) Fixed bridges	72 (3·30 m.). (N.B. Water depth under Amiens bridges may fall to 1·65 m. Navigators must refer to water level scales)
(f) Tunnels	None
(g) Traction	Horse and tractor. Metalled towpath
(h) Tonnage (1936)	764,000
(i) Barge journeys (1936)	3,038

The Somme Canal links that of St Quentin with the sea. It starts at St Simon on the St Quentin Canal and follows the Somme as a lateral canal to Froissy at Bray-sur-Somme. From Froissy to Abbeville it utilizes the bed of the river with occasional cuts across the bends. The cultivated slopes of the valley, which is deeply trenched into the chalk, drop steeply to a level marshy floor covered with osier beds. The maritime part of the canal begins at Abbeville and enters the Baie de la Somme at St Valéry-sur-Somme. The traffic of the Somme and its lateral canal leading to Abbeville is small in amount owing to inadequate contact with the sea, for the building out of the coast and the silting of the river bed have gone hand in hand. But at any rate the canal serves to bring the considerable town of Amiens into contact with the main water routes. The volume of traffic averages about three-quarters of a million metric tons. Nearly one-half of this consists of upstream cargoes of cotton and



wool for Amiens and surrounding textile districts, and a large part of the remainder is agricultural produce, notably sugar beet.

Ports	Km.	Wharves, factories, etc.
St Valéry-sur-Somme	0	Maritime port (pp. 84-5). Sidings on Nord Railway. Timber yards
Abbeville	14	Public wharves serving textile industry
Amiens	57-60	Railway centre. Public and private wharves serving textile centre and market town
Laneuville	103	Public and private ports
Frise	112	Private and public wharves. Refinery
Eppeville (0.17 M.m.t.)	148	Public and private wharves
St Simon	156	Wharves
(St Quentin C.)		

### SEINE BASIN

This system includes (1) the major tributaries of the Seine which converge in the neighbourhood of Paris, (2) the lateral canals which supersede these tributaries when they are navigationally unsuitable, and (3) the canals which join the group to the other waterways of France (Figs. 114, 116).

Relief, climate and rock structure combine to ensure a sufficient and regular flow. All the tributaries are not normally in flood or deficient in supply at the same time. When, however, heavy rains are experienced in the whole basin at once, or when melting snows in the Morvan are accompanied by great downpours in other parts of the basin, then the convergence of streams in the neighbourhood of Paris has its disadvantages and even dangers, as extensive flooding may occur. Bridges are no longer negotiable, the navigable channel ceases to be recognizable, and the current becomes too powerful for barges. Sluice gates have to be opened to let the water get away downstream as rapidly as possible.

Along the main river valleys of the Aisne, the Oise and the Marne, as well as along the connecting canals, a large number of industrial concerns have sprung up, increasing in size as the capital is approached. These are served by coal from the north-east and by coke from the gas works of Paris. Among the headwaters of the Somme and of the Aisne are a number of textile industries at St Quentin, Vermand, Amiens and Reims, corresponding to those on the other side of the Artois-Picardy ridge. These also are served by the canals that join the two river systems.

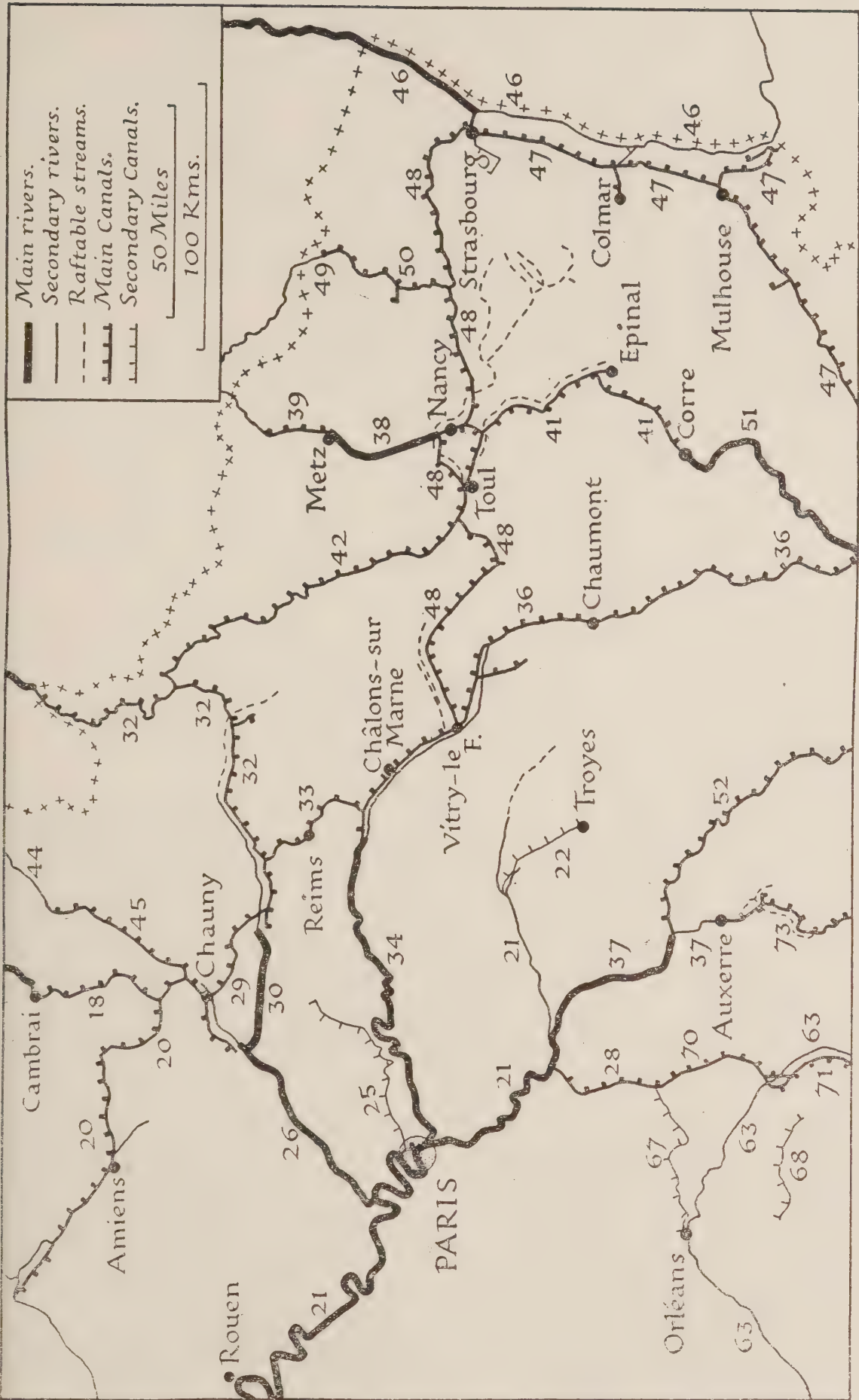


Fig. 116. Waterways of the Seine Basin and eastern France



## DETAILS OF THE SEINE WATERWAYS

21. *River Seine*

The Seine bears the greatest volume of tonnage of any French waterway. This is due in the first place to cargoes which are unshipped at Havre or Rouen into river craft and conveyed upstream to the industrial agglomeration of Greater Paris, and in the second place to the cargoes from north-eastern and eastern France which are carried along the right-bank tributaries.

As a result, out of the 141 ports which returned figures of over 100,000 metric tons of river- or canal-borne traffic in 1936, forty-four were situated on the banks of the Seine and another fourteen on its tributaries.

21. *River Seine—Section (i). Estuary to Rouen*

(a) Freycinet classification	Main
(b) Length	150 km.
(c) Depth	6.00 m. (min.); 7.50 m. (mean)
(d) Locks	None
(e) Fixed bridges	5 (variable—tidal, 0-4.70 m.)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	2,219,000
(i) Barge journeys (1936)	7,974

The river is tidal as far as the bridgehead of Boïeldieu at Rouen, and as the average depth is over 6 m. there is always sufficient water. Between Havre and Rouen the river flows in great loops trenched deeply into the limestone plateaux (Fig. 15), so that the valley is enclosed between steep wooded cliffs. The deep incision of these meanders makes any major rectification impracticable, which is unfortunate since the winding of the river adds about 150 km. to its course.

River navigation, strictly speaking, is not greatly concerned with the Seine below Rouen, for most of the vessels coming up to that port are sea-going craft (Plates 9, 11). A large proportion of the traffic on the Seine between Havre and Rouen consists of coal, mainly British, but also from Germany and Poland. Colliers carrying up to 1,000 tons often make three trips a month between the Welsh ports and Rouen docks. River navigation proper is largely concerned with the re-distribution of this coal from the great depot at Rouen, mainly to Paris.

Ports	Km.	Wharves, factories, etc.
Havre (1.34 M.m.t.)	0	See pp. 41-51. Entrepôt port handling imports of cotton, wool, coal, etc.
Honfleur	10	Wharves
Tancarville (canal junction)	28	Wharves
Port Jérôme (0.68 M.m.t.)	33	
Rouen (4.34 M.m.t.) (Port Boieldieu)	125	Road and rail port serving extensive textile and cellulose factories, dye works, paper factories, etc. Lowest bridge point. Coal, oil, wine and timber wharves. (See pp. 51-62)

## 21. River Seine—Section (i) a. Tancarville Canal (Fig. 15)

(a) Freycinet classification	Main
(b) Length	25 km.
(c) Depth	3.00 m. (min.); between Havre and 7th bridge 9.15 m.; between 7th bridge and 15 km. 6.65 m.
(d) Locks	2 (F)
(e) Fixed bridges	5 (1.00 m. at high water)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	1,700,000
(i) Barge journeys (1936)	5,989

Navigation in the estuary is difficult on account of the swift tidal currents, although shifting channels have been regularized in recent years. Moreover, there is a tidal bore that can be troublesome to small craft. Dredging, however, has caused it to be felt only when the tide is of more than 8 m. amplitude, that is, only on 20-25 days a year. For these reasons, river craft use the Tancarville Canal which follows the foot of the chalk Plateau du Caux, although sea-going vessels largely use the river. About one million metric tons of goods were carried upstream through the canal, and 600,000 metric tons passed down in 1936. Over half this tonnage in each case was petroleum products, and much of the remainder consisted of coal. These cargoes are carried in sea-going vessels. In addition, a small number of *péniches* use the canal. (See also p. 64.)

Ports	Km.	Wharves, factories, etc.
Havre (1.34 M.m.t.)	0	Extensive wharves
Orcher (0.55 M.m.t.)	12	Extensive wharves
Tancarville	25	Extensive wharves



21. *River Seine—Section (ii). Rouen to Andresy (Oise confluence)*

(a) Freycinet classification	Main
(b) Length	170 km.
(c) Depth	3·20 m.
(d) Locks	6 (F)
(e) Fixed bridges	17 (variable, min. 2·97 m.)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	6,995,000
(i) Barge journeys (1936)	22,452

Rouen, the third greatest inland port, stretches along the river for 13 km. from Boïeldieu Bridge to Oissel (Figs. 12, 13). It is the seaport of Paris, and serves also its own group of satellite textile centres. Of the sea-borne imports of Rouen, over half is moved inland by river transport, the equipment of which comprised in 1936 500 motor barges, 770 towed barges, 265 oil-tanker barges and 39 wine-tanker barges.

In 1936 it handled 4,340,000 metric tons, of which 3,329,000 metric tons proceeded upstream. The chief commodities sent in that direction were imported coal, petroleum products, wines and spirits, wood pulp, metals, machinery and fertilizers. The much smaller downstream traffic consisted of agricultural produce, manufactured textiles, coal from the north-east, building stone and other constructional material, plaster of Paris from the Marne, and soda and salt from Lorraine for its bleaching and chemical works. Some of the traffic to Paris is seasonal, for example wine from Bordeaux and North Africa, and timber, which is forwarded during the summer and autumn.

A number of improvements have been made in the Seine waterway above Rouen; and the new weirs on the Seine claim world records for the size of their sluices, which are designed to mitigate the danger of the floods from which Paris has suffered so severely in the past. Between Rouen and Andresy there is a constant succession of wharves and quays, with coal depots, oil refineries and factories (Plate 86).

Ports	Km.	Wharves, factories, etc.
Rouen (4·34 M.m.t.) (Port Boïeldieu)	125	See pp. 51–62
River port continues to Oissel	138	Quays on both banks with modern equipment. Wharves
Amfreville-sous-les- Monts	162	World's biggest sluices
Mantes (0·11 M.m.t.)	211	
Guerville (0·23 M.m.t.)	259	Wharves
Poissy (0·12 M.m.t.)	287	Wharves serving Ford motor works
Andresy (Oise con- fluence)	296	Basins for 60 and 20 barges. Wharves





Plate 86. River Seine above Rouen (looking upstream)

The river contains numerous long islands, forming a double navigable channel and providing additional quay space. The bridge carries the main Paris-Havre railway which tunnels through the chalk cliff forming the high right bank; on the lowlying left bank is the Sotteville marshalling yard. (See p. 315.)



Plate 87. River Seine at Paris (looking upstream), Quai St Bernard

The Quai St Bernard is the chief wine quay in Paris; to the right, off the plate, lies the Halle aux Vins. In the distance is the Pont d'Austerlitz, behind which lies the steel bridge carrying the Métro (see also Fig. 102). To the left of the Austerlitz bridge can be seen the chimneys of one of the water-works.





Plate 88. River Seine at Paris (looking upstream)

There is normally a large amount of pleasure traffic on the river; this view, however, was taken during a strike of the Paris watermen, and the boats are laid up alongside the Quai Bleriot. On the right can be seen one of the Citroën factories, and in the distance the Pont Mirabeau and the Tour Eiffel.



Plate 89. River Yonne at Sens

While not as important as the other Seine tributaries, the Yonne has been regularized and carries some 100,000 tons of freight annually.

21. *River Seine—Section (iii). Andresy to La Briche*

(a) Freycinet classification	Main
(b) Length	42 km.
(c) Depth	3·20 m.
(d) Locks	1 (F)
(e) Fixed bridges	12 (variable, min. 3·19 m.)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	9,493,000
(i) Barge journeys (1936)	32,784

Just above Andresy the Oise joins the Seine, bringing coal from the north-east and from Belgium, and chemicals, building materials, salt and pig-iron from Lorraine. Much of the downstream traffic on this section is destined for the Oise and consists to a large extent of coke from the Paris gas works for household and industrial consumption. In return, iron and iron pipes from Lorraine come via the Marne through Paris for the industries of the lower Oise. The river port of Paris begins at Nanterre on the edge of the industrial region of Greater Paris. Along the 10 km. reach between Nanterre and La Briche, there are important industrial concerns which continue all the way to Paris.

Ports	Km.	Wharves, factories, etc.
Andresy	296	
Conflans-Ste Honorine (0·19 M.m.t.)	298	Basins for 200 and 50 barges
Sartrouville (0·43 M.m.t.)	309	
Port Marly	318	Wharves
Bezons (0·10 M.m.t.)	328	
Nanterre (0·48 M.m.t.)	328	Public and private wharves. Industrial region of Greater Paris begins
Colombes	330	Wharves serving motor-car works and metallurgical industry
Argenteuil (0·14 M.m.t.)	331	Wharves serving motor-car works
Gennevilliers (0·71 M.m.t.)	333	Coke distributing port. Public and private wharves serving electricity and gas works and motor-car works. Large railway sidings
La Briche (0·22 M.m.t.) (St Denis C.)	338	Wharves

21. *River Seine—Section (iv). La Briche to Portes-de-Billancourt*

(a) Freycinet classification	Main
(b) Length	21 km.
(c) Depth	3·20 m.
(d) Locks	3 (F)
(e) Fixed bridges	17 (2·78 m. at highest water)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	8,758,000
(i) Barge journeys (1936)	32,269



Factories and wharves continue to line the river, and there is a succession of towns which form the industrial suburbs of Paris.

Ports	Km.	Wharves, factories, etc.
La Briche (0·22 M.m.t.) (St Denis C.)	338	
Ile St Denis (0·51 M.m.t.)	339	Wharves serving steel casting and general metallurgical factories
St Ouen (0·49 M.m.t.)	341	Nord and Grande Ceinture Railways. Wharves and dock basins
Asnières (0·11 M.m.t.)	344	Wharves serving machine-tool factories
Levallois-Perret	345	
Courbevoie (0·16 M.m.t.)	348	Wharves serving motor works and steel casting factories
Puteaux (0·14 M.m.t.)	350	Wharves serving aero and motor works
Boulogne-sur-Seine	354	Wharves of Port Legrand serving aero and motor works
Sèvres (0·15 M.m.t.)	355	Wharves of Port de la Rue Legrand serving aero, motor and porcelain factories
Issy-les-Moulineaux (0·29 M.m.t.)	358	Wharves serving alimentary, chemical, soap, leather and metallurgical factories
Portes-de-Billancourt (0·63 M.m.t.)	359	Wharves. Extensive factories

## 21. *River Seine—Section (v). Within the Municipality of Paris*

(a) Freycinet classification	Main
(b) Length	12 km.
(c) Depth	3·20 m.
(d) Locks	None
(e) Fixed bridges	38, including 27 over main channel (F)
(f) Tunnels	None
(g) Traction	Tug. Towing chain laid in bed of branch between Ile de la Cité and left banks. Con- creted banks
(h) Tonnage (1936)	9,644,000
(i) Barge journeys (1936)	37,849

This section serves the port of Paris proper and lies within the jurisdiction of the municipality. Its banks are of concrete throughout its whole length; there are twenty-five quays with a total length of 12,540 m. and a width varying from 10 to 70 m. The channel is split up by a number of islands. The main navigable channel, known as the Grand Bras de Grenelle, follows the right bank between the Quai de Passy and the Ile-aux-Cignes, and so along the Ile de la Cité; after this it crosses to the left bank and follows the Ile St Louis. The minor channel between the Ile de la Cité and the left bank of the river is known as the Bras de la Monnaie; the current here is very slow, and this branch is largely used by upstream traffic (Plates 87, 88).

The bridges in this section frequently offer difficulties to navigation at high water.

With its large population and its well-developed industries, Paris requires immense quantities of heavy and bulky goods for local consumption. The traffic of the municipality in 1936 was made up as follows:

	No. of vessels	Total tonnage metric tons	Percentage of total
Departing traffic	7,120	1,508,920	15
Arriving traffic	18,919	4,919,803	51
Traffic in transit	11,574	3,142,325	33
Local traffic	236	72,657	1
Total	37,849	9,643,705	100

The routes taken by incoming and outgoing traffic (not including cargoes in transit which totalled about 3 million metric tons) in 1936 are as follows:

Route	Outgoing traffic from Paris		Incoming traffic to Paris	
	Metric tonnage	No. of vessels	Metric tonnage	No. of vessels
Havre (via Seine)	212,234	1,627	1,581,010	5,331
Belgian frontier and the north-east ports (via Oise, St Quentin C., etc.)	179,499	849	841,861	3,185
Ditto (via Aisne, etc.)	10,674	53	39,173	164
Eastern France (via the Marne, etc.)	36,848	179	327,534	1,364
Lyons	1,009,363	4,025	1,883,422	7,556
Loire and Western France	60,302	387	194,239	7,762
Ourcq Canal	Nil	Nil	52,564	357
Total	1,508,920	7,120	4,919,803	25,719

This traffic was made up as follows:

	To Paris Metric tons	From Paris Metric tons
Coal and coke	1,072,660	66,219
Building materials and timber	2,626,161	914,499
Fertilizers, etc.	114,956	85,952
Firewood	36,809	21,306
Metals and machinery	89,386	5,955
Metallic ores, pig- and scrap-iron, castings, etc.	143,741	202,995
Non-metalliferous manufactured goods	100,576	41,003
Agricultural produce, including raw wool and cotton	421,522	79,054
Petroleum and other hydrocarbons	104,653	5,638
Various	209,339	86,299
Total	4,919,803	1,508,920



Paris is much more a receiving than a dispatching centre; the incoming traffic consists mainly of such items as coal and building materials essential for a large city. Most of the exports of the city are of luxury goods which can stand rail freight charges.

It is surprising in some ways that the heaviest volume of traffic to and from Paris comes from the Lyons direction via the upper Seine and the Burgundy Canal. This is explained by the nature of the goods which consists mainly of heavy building materials; these include incoming cargoes of Jurassic limestone and Morvan timber, and outgoing cargoes of lime, cement, bricks and plaster of Paris. The traffic upstream includes coal from Britain, wool, mineral oils, metallic ores, etc.; the downstream traffic to Havre is relatively light (under a quarter of a million tons). The third greatest volume of incoming tonnage consists of coal and food products (wheat and sugar) from the north-east of France.

Local traffic is relatively small, consisting of refuse which is dumped in stone quarries on the outskirts and of sewage.

In addition to the main waterway of the Seine the municipality of Paris possesses three canals—the St Denis, the St Martin and the Ourcq, which are described on pp. 386–7 (nos. 23–25).

Ports	Km.	Wharves, factories, etc.
Portes-de-Billancourt (0.63 M.m.t.)	359	Concreted banks. 25 quays with total length of 12,540 m. serving great variety of industries. Floating and land cranes
Charenton	370	Numerous railway sidings

## 21. *River Seine—Section (vi). Charenton to Montereau*

(a) Freycinet classification	Main
(b) Length	98 km.
(c) Depth	2.00 m.
(d) Locks	9 (F)
(e) Fixed bridges	20 (F)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	7,630,000
(i) Barge journeys (1936)	30,745

The river flows here in a broad valley between the low limestone plateaux of Brie and Beauce. The edges of the valley are steep and are frequently wooded. This section, although not comparable with the lower river or with the Oise, carries a fair amount of traffic—some 350,000 metric tons per annum. The river is canalized and conditions of navigation are good.

Ports	Km.	Wharves, factories, etc.
Charenton (near R. Marne confluence)	370	
Ivry-sur-Seine (0·75 M.m.t.)	371	Large public wharves with quay 270 m. long serving power station and petrol storage tanks. Floating landing stage. Railway sidings
Vitry (0·13 M.m.t.) (R. Marne confluence)	373	
Alfortville (0·46 M.m.t.)	374	Coal and coke wharves serving power stations and gas works
Choisy-le-Roi	379	Barge building yards. Public wharves. Sand pits
Villeneuve-le-Roi (1·36 M.m.t.)	383	Barge building yards. Extensive wharves. Sand pits
Athis	388	Coal wharves. Sand pits
Juvisy (0·12 M.m.t.)	388	Railway sidings
Châtillon (0·18 M.m.t.)	389	
Vigneux (1·29 M.m.t.)	389	Wharves. Railway sidings
Corbeil (0·29 M.m.t.)	402	Railway sidings. Wharves serving saw-mills (pit-props)
Melun (0·19 M.m.t.)	427	Public and private wharves serving agricultural region. Grain storage
Vaux (0·16 M.m.t.)	429	
Fontaine-le-Port	439	Private timber wharves serving saw mills (pit-props)
Valvins (0·12 M.m.t.)	447	Wharves
St Mammès (Loing C.)	455	Wharves
Varennes	465	Wharves serving clay pits
Montereau (0·19 M.m.t.) (R. Yonne confluence)	468	P.L.M. railway sidings. Extensive wharves serving power station, chemical factories and brickworks. Basin for 15 barges

## 21. *River Seine—Section (vii). Montereau to Marcilly*

(a) Freycinet classification	Secondary
(b) Length	68 km.
(c) Depth	1·60 m.
(d) Locks	17 barrages + 13 locks (F, except depth 1·60 m.)
(e) Fixed bridges	45 (3·55 m.)
(f) Tunnels	None
(g) Traction	Horse and tug. Towpath metalled in part
(h) Tonnage (1936)	191,000
(i) Barge journeys (1936)	1,007

In this section the river flows in a broad valley along an outcrop of clay at the foot of the limestone escarpment which rises steeply to the north of the river. To the south the chalk plain of Champagne rises more gently. The course of the stream is tortuous and braided, and its channel has been regulated and simplified by numerous cuts from 2 to 13 km. long.

## 22. *Haute-Seine Lateral Canal*

(a) Freycinet classification	Secondary
(b) Length	44 km.
(c) Depth	1·70 m.
(d) Locks	20 (F)



(e) Fixed bridges	21 (3·57 m.)
(f) Tunnels	None
(g) Traction	Horse and tractor. Gravelled towpath
(h) Tonnage (1936)	9,900
(i) Barge journeys (1936)	109

The upper Seine is not navigable above Marcilly, and a short lateral canal has been constructed from that point to Troyes. Traffic is, however, small and consists chiefly of timber barges.

### 23. *St Denis Canal*

(a) Freycinet classification	Main
(b) Length	6·64 km.
(c) Depth	2·60 m.
(d) Locks	None
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Electric tractor. Metalled towpath
(h) Tonnage (1936)	2,527,000
(i) Barge journeys (1936)	9,915

This short canal lies entirely within Greater Paris, and is under the jurisdiction of the Paris corporation. It begins at the Villette Basin, by means of which it receives its water supply from the Ourcq Canal. With the St Martin Canal it forms a direct line from La Briche to the Arsenal and cuts across the great loop of the Seine that encloses the Bois de Boulogne.

Ports	Km.	Wharves, factories, etc.
Villette Basin (Ourcq C.)	0	Dock basin with wharves serving miscellaneous industries
Port-de-Flandre	1	Docks and warehouses of Cie des Magasins généraux de Paris. Railway sidings
Aubervilliers (0·65 M.m.t.)	2	Railway sidings
Stains (0·23 M.m.t.)	5	Wharves
La Briche (0·22 M.m.t.) (R. Seine)	7	4 km. of wharves
St Denis (0·52 M.m.t.)	7	Wharves

### 24. *St Martin Canal*

(a) Freycinet classification	Main
(b) Length	5 km.
(c) Depth	1·90 m.
(d) Locks	9 (F)
(e) Fixed bridges	3 (F)
(f) Tunnels	1 (82 m. × F). In addition canal is covered for 2,000 m.
(g) Traction	Electric capstan. Metalled or paved towpath
(h) Tonnage (1936)	685,000
(i) Barge journeys (1936)	3,210

The canal connects the Seine at the Arsenal in central Paris with the Villette Basin in north-eastern Paris and so with the St Denis

and Ourcq Canals (Plate 90). It crosses the limestone ridge of Belleville-Montmartre by a tunnel 82 m. long. It is also covered for a distance of 2,000 m. between the Temple Faubourg and the Arsenal.

Ports	Km.	Wharves, factories, etc.
Villette Basin (Ourcq and St Denis C.)	0	Dock basin with wharves serving industrial Paris
Arsenal	5	Basin for 70 barges

## 25. *Ourcq Canal*

This system comprises the Villette Basin, a secondary canal and the canalized river Ourcq for a short distance.

	(i) Villette Basin	(ii) Canal	(iii) River
(a) Freycinet classification	Main	Secondary	Secondary
(b) Length	11 km.	85 km.	11 km.
(c) Depth	2.60 m.	0.90 m.	0.90 m.
(d) Locks	10 (58.50 × 3.20 × 2 m.)	10 (58.50 × 3.20 × 2 m.)	10 (58.50 × 3.20 × 2 m.)
(e) Fixed bridges	45 (2.97 m.)	45 (2.97 m.)	45 (2.97 m.)
(f) Tunnels	None	None	None
(g) Traction	Tug haulage. Metalled towpath	Tug haulage. Metalled towpath	Tug haulage. Metalled towpath
(h) Tonnage (1936)	Including (ii) & (iii) 905,000	Included in section (i)	Included in section (i)
(i) Barge journeys (1936)	Including (ii) & (iii) 7,319	Included in section (i)	Included in section (i)

Vessels cannot pass each other if their dimensions exceed 28.50 m. by 3.05 m., so that goods arriving by large boats from the Seine and Marne have to be transhipped. The chief function of the Ourcq Canal is to serve the industrial district between St Lazare and Villette, and to supply water to the canals of St Denis and St Martin by means of the Villette Basin which lies on the water-parting between them.

## 26. *River Oise*

(a) Freycinet classification	Main
(b) Length	104 km. (is navigable farther up, but traffic passes to Lateral Canal)
(c) Depth	2.50 m. (min.); 2.60 m. (mean)
(d) Locks	7 weirs with locks (F)
(e) Fixed bridges	24 (3.20 m. at highest water)
(f) Tunnels	None
(g) Traction	Horse and tug. Metalled towpath
(h) Tonnage (1936)	6,065,000
(i) Barge journeys (1936)	23,730

The river flows in a deep, trough-like valley cut in the chalk, and is fed almost entirely by springs that issue from fissured chalk in the valley bottoms. The supply of water is therefore gentle and regular, and very little silt is deposited in the channel. The looped



and braided course of the river, winding in its level flood-plain, is rectified at intervals by artificial cuts. It differs from the other canalized tributaries of the Seine in having a relatively well-graded valley that needs but few locks.

From Compiègne downstream the Oise valley becomes increasingly industrial and has the heaviest traffic of all the Seine tributaries (Plate 91). It taps the north-east industrial region by way of the St Quentin Canal, the Belgian coalfield via the canalized Sambre, and the Mézières metallurgical district of the Meuse by the Aisne river and the Ardennes Canal. To feed the varied industries, coal passes downstream from France, Belgium, Holland and Germany; domestic coke moves upstream from the Paris gas works; salt, ore and pig-iron come down from Lorraine, and sand, stone, timber and cement move in both directions.

Ports	Km.	Wharves, factories, etc.
Andresy (above Conflans- Ste Honorine)	0	Wharfage of 12,000 sq.m. Sidings connected with Etat Railway
Maurecourt	1	Dock for 150 barges. Boat-building yards.
Neuville (0.18 M.m.t.)	3	Wharves serving timber yards and saw mills Private wharves serving sand pits
Pontoise	14	Coal and brick depots. Wharves
St Ouen-L'Aumône	16	Extensive private wharves serving sugar refineries, chemical works and distilleries
Méry-sur-Oise	21	Wharves serving stone quarry
Mériel	24	Private wharves serving stone quarries
Persan	34-38	Wharves serving cement works, paper mills, brick works, chemical works and rubber factories
Beaumont (0.27 M.m.t.)	35	Wharves serving lime kilns
Précý	45	Nord Railway. Wharves serving timber yards, saw mills and cement works
St Maximin	53	Wharves serving saw mills and quarries
Montataire	54	Private wharves serving machinery and engineering works
Creil	58	Public and private quays connected with Nord Railway serving engineering works, bleaching and dye works
Villers-St Paul	62	Private wharves serving bleaching and dye works, and works of Vieille Montagne Zinc Co.
Pont-Ste Maxence	70	Private wharves serving foundry and pottery works
La Croix-St Ouen	88	Private wharves. Oil and petrol depot
Compiègne (0.11 M.m.t.)	98	Public and private wharves serving glass works, chemical works, iron and bronze foundries, and soap and tallow factories
Clairoix (Aisne confluence)	100	Private wharves serving rubber factory
Choisy-au-Bac	102	Boat-building yards
Janville (Oise Lateral C.)	104	Barge basin. Boat-building yards. Wharves





Plate 90. St Martin Canal

This canal traverses one of the most populous parts of Paris. The view shows a barge negotiating one of the nine locks, necessitated by the 25 m. difference in height between the Villette Basin and the Seine.





Plate 91. River Oise above Compiègne (looking upstream)

Tug haulage is used on the larger rivers.

27. *Oise Lateral Canal*

(a) Freycinet classification	Main
(b) Length	34 km.
(c) Depth	2.40 m.
(d) Locks	4 double (F)
(e) Fixed bridges	20 (F)
(f) Tunnels	None
(g) Traction	Electric tractor. Metalled towpath
(h) Tonnage (1936)	6,624,000
(i) Barge journeys (1936)	25,737

This canal follows the Oise from Janville to Chauny at the junction of the St Quentin Canal, and forms part of the through-route between Paris and the north-eastern coalfield. It enables vessels to avoid the bad bend in the Oise at Pimprez. Apart from through-traffic, it deals mainly with timber and timber products for local consumption. Pit-props are carried from the local forests to the coalfield.

Ports	Km.	Wharves, factories, etc.
Janville (R. Oise)	0	See (26)
Thourotte	4	Private wharves serving chemical and glass works
Béthancourt	5	Basin for 25 barges
Ribécourt	8	Public and private wharves serving chemical works
Pont l'Evêque	16	Wharves and railway sidings. Warehouses
Sempigny	17	Basin for 12 barges. Timber wharves and saw mills
Abbécourt (Oise-Aisne C.)	31	Basin for 50 barges. Timber wharves and saw mills
Chauny (0.14 M.m.t.) (St Quentin C.)	34	Public wharves (see (18))

28. *Loing Canal*

(a) Freycinet classification	Main
(b) Length	50 km.
(c) Depth	2.00 m.
(d) Locks	20 (F)
(e) Fixed bridges	29 (3.30 m.)
(f) Tunnels	None
(g) Traction	Horse and tractor. Towpath paved or gravelled
(h) Tonnage (1936)	Included in return of Briare Canal
(i) Barge journeys (1936)	Included in return of Briare Canal

This is a continuation of the Briare and Orléans Canals which connect the Seine and Loire. It is lateral to the Loing, an upper tributary of the Seine.

Ports	Km.	Wharves, factories, etc.
St Mammès (Seine)	0	Repair yards for barges. Wharves
Nemours (0.16 M.m.t.)	20	Wharves serving sand pits
Buges (Orléans C. and Briare C.)	50	Wharves



29. *Oise-Aisne Canal*

(a) Freycinet classification	Main
(b) Length	48 km.
(c) Depth	2.60 m.
(d) Locks	13 (F)
(e) Fixed bridges	42 (F)
(f) Tunnels	1 (2365 m. × 8 m. wide × 3.70 m. clearance)
(g) Traction	Electric tractor. Paved towpath
(h) Tonnage (1936)	1,964,000
(i) Barge journeys (1936)	7,726

This canal, using in large part the valley of the Ailette, cuts across from the Oise at Abbécourt to the Aisne at Bourg, crossing the water-parting in the tunnel of Braye-en-Laonnais. It allows vessels to avoid the acute angle formed by the convergence of the two rivers, and forms, together with the Aisne-Marne Canal, a link in the chain of waterways that joins the north both with the Saône, and with Alsace-Lorraine. It was badly damaged in the war of 1914-18 and has since been completely reconstructed. Its temporary abandonment entailed a diversion of about 55 km., a serious matter, since it carried some two million metric tons of coal per annum. Its equipment is now up to date. Hydraulic pumps at Bourg-et-Comin have been electrified, and an improved water supply has been provided from the Monampeuil reservoir. Coal, salt, timber and pig-iron are conveyed to the industrial centre of Chauny, and there is a considerable through-traffic which amounted in 1928 to about six million metric tons.

Ports	Km.	Wharves, factories, etc.
Abbécourt (Oise Lateral C.)	0	Canal junction. Extensive wharves serving chemical works
Pont-St Mard	12	Public and private wharves. Petroleum refinery and depot. Turning basin. Railway sidings
Anizy-Pinon	26	Public and private wharves. Turning basin
Braye-en-Laonnais	39	Tunnel. Wharves
Bourg-et-Comin (Aisne Lateral C.)	48	Wharves and turning basin

30. *River Aisne*

(a) Freycinet classification	Main
(b) Length	57 km.
(c) Depth	2.10 m.
(d) Locks	7 (F)
(e) Fixed bridges	17 (F)
(f) Tunnels	None
(g) Traction	Horse and tug. Metalled towpath
(h) Tonnage (1936)	1,317,000
(i) Barge journeys (1936)	5,586

The Aisne is canalized between the Oise confluence and Celles, at which point traffic leaves the river and proceeds by a lateral canal

to Vieux-les-Asfeld, where the Ardennes Canal picks it up. The upper river, about 180 km. in length, is now only used for rafting timber, which is the main commodity it receives from the Ardennes Canal.

At first the river flows from south to north through the clay plain of the Argonne district that lies at the foot of the chalk escarpment of Champagne. The valley is marshy and the course of the river is sluggish and meandering, but it receives a supply of water from its tributaries in the forest ridges of the Argonne to the east. Just below Rethel the Aisne turns west and cuts its way into the chalk plateau of Champagne to the north of Reims. The valley is characteristic of the chalklands—wide, flat-bottomed, steep-sided, with a marshy flood-plain receiving plentiful spring water from the valley sides and floor, and little water from surface streams. Below Bourg the Aisne flows due west between the Tertiary limestone blocks of Laonnais and Soissonais in a broad level valley where it is joined by a number of short tributaries.

Traffic consists mainly of German, Belgian and French coal proceeding downstream towards Paris, together with timber from the Ardennes. Fuel and raw materials to supply the varied industries of Soissons and sugar beet for the numerous refineries along the banks are also conveyed.

Ports	Km.	Wharves, factories, etc.
Claroix (R. Oise)	0	Private timber wharves serving saw mills
Rethondes	9	Timber wharves serving saw mills
Berneuil	13	Wharves serving sugar refinery
Lamotte	14	Private wharves of chemical works
Vic-sur-Aisne	24	Private wharves serving quarries and distilleries
Vauxrot	40	Private wharves serving distilleries. Nord Railway sidings
Soissons	42	Public and private wharves serving agricultural machinery factories, iron and copper foundries, boiler works, engineering works, tyre works, paper and printing works. Grain storage depot
Celles (Aisne Lateral C.)	57	Private wharves

### 31. *Aisne Lateral Canal*

(a) Freycinet classification	Main
(b) Length	51 km.
(c) Depth	2.20 m.
(d) Locks	8 (F)
(e) Fixed bridges	34 (F)
(f) Tunnels	None
(g) Traction	Tractor. Paved or metalled towpath
(h) Tonnage (1936)	2,898,000
(i) Barge journeys (1936)	11,923



The line of the Aisne and of the Ardennes Canal is continued by the Aisne Lateral Canal. Its traffic mainly consists of timber, sugar beet and sugar.

Ports	Km.	Wharves, factories, etc.
Celles (R. Aisne)	0	
Vailly	3	Boat-building and repairing yards. Basin for 100 barges. Wharves
Bourg-et-Comin (Oise-Aisne C.)	12	Wharves. Basin for 30 barges
Maisy	18	Deep-water basin for 100 barges. Turning basins. Wharves serving saw mills
Berry-au-Bac (Aisne-Marne C.)	32	Boat-building yards. Private wharves of chalk quarries and brick yards
Guignicourt	38	Wharves serving sugar refinery
Vieux-les-Asfeld (Ardennes C.)	51	

### 32. *Ardennes Canal*

(a) Freycinet classification	Main
(b) Length	88 km.
(c) Depth	2.00 m.
(d) Locks	44 (F)
(e) Fixed bridges	66 (3.55 m.) (including bridges on Vouziers Branch)
(f) Tunnels	One 196.50 × 4 m. clearance
(g) Traction	Tractor, tug and horse. Paved towpath
(h) Tonnage (1936)	1,372,000
(i) Barge journeys (1936)	5,852

This canal follows the Aisne valley from Vieux-les-Asfeld to Rilly; it then tunnels through the water-parting over the Jurassic limestone hills that flank the Ardennes, to the metallurgical centre of Charleville-Mézières.

It carries mainly timber and coal. The timber is for the Aisne industries, for fuel, for constructional purposes, and for pit-props to be sent to the north-eastern coalfields. The coal comes mainly from the Liège district in Belgium.

Ports	Km.	Wharves, factories, etc.
Vieux-les-Asfeld (Aisne Lateral)	0	Wharves
Balham	6	Private wharves serving sugar refinery
Taizy	18	Wharves serving sugar refinery. Turning basin
Attigny	48	Private and public wharves. Refinery
Rilly (Vouziers branch)	49	
Pont-à-bar (R. Meuse and Est C., Northern branch)	86	Wharves and turning basin

*Vouziers Branch of the Ardennes Canal*

(a) Freycinet classification	Main
(b) Length	12 km.
(c) Depth	2.00 m.
(d) Locks	4 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Tractor and horse. Paved towpath
(h) Tonnage (1936)	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal

A short branch of the Ardennes Canal follows the right-angled bend of the Aisne southward as far as Vouziers.

33. *Aisne-Marne Canal*

(a) Freycinet classification	Main
(b) Length	58 km.
(c) Depth	2.00 m.
(d) Locks	24 (28.50 m. long)
(e) Fixed bridges	41 (3.60 m.)
(f) Tunnels	One (2300 m. × 6 m. wide × 4 m. clearance)
(g) Traction	Electric tractor. Paved towpath
(h) Tonnage (1936)	1,954,000
(i) Barge journeys (1936)	8,021

This canal crosses the water-parting between the Vesle and the Marne in a tunnel at Mont-de-Billy. Since the war of 1914-18, improved haulage facilities have speeded up traffic and have played a great part in the reconstruction of the sorely damaged industries of Reims. The canal serves the Champagne wine district and a number of sugar refineries and glass works that have wharves along its banks. It brings coal for the woollen mills and iron from Strasbourg for the metallurgical works of Reims, while sand for its glass works is brought by water from Messein on the Est Canal, and potash is imported from Strasbourg. Reims has a new river port equipped on modern lines and is able to take advantage of the improved transport on the canal. In 1936 it handled nearly half a million metric tons of goods, of which four-fifths (consisting of foodstuffs, petroleum and charcoal) were imported into the town.

Ports	Km.	Wharves, factories, etc.
Berry-au-Bac (R. Aisne, Aisne Lateral C.)	0	Wharves
St Brice	21	Wharves serving brick and glass works. Petrol storage. Railway sidings
Reims (0.44 M.m.t.)	23	New river port equipped on modern lines (14 barges can berth at a time). Coal storage bunkers. Wharves serve sugar refineries, glass works, woollen mills and metallurgical industries
Mont-de-Billy	47	Tunnel
Condé-sur-Marne (Marne Lateral C.)	58	Wharves



34. *River Marne*

(a) Freycinet classification	Main
(b) Length	182 km.
(c) Depth	2.20 m.
(d) Locks	21 (F)
(e) Fixed bridges	63 (F)
(f) Tunnels	Two (i) 600 × 10 × 7 m., (ii) 300 × 9 × 3.14 m.
(g) Traction	Horse and tug. Gravelled towpath
(h) Tonnage (1936)	1,534,000
(i) Barge journeys (1936)	6,450

Although having a greater water supply than the Oise, the Marne is less effective as a waterway. This is due mainly to the fact that it draws its waters largely from the heavy clays of Bassigny and Perthois, and is more liable to flood in winter, while in summer supply from these regions dwindles rapidly during periods of drought.

The river is canalized as far as Epernay. It approaches Paris from the west across the high plains of the Ile-de-France in a series of great loops trenched deep in hard limestone. As in the case of the lower Seine, the incised nature of these valley loops prevents the shortening of the waterway on any large scale, except in the neighbourhood of Paris, where there are three derivation canals, two of which have to be led through tunnels.

The river connects the most important industrial regions of France with Paris, and in its lower course especially serves a more or less continuous industrialized urban area. Coal, sand, gravel, lime, cement, basic slag, and pit-props form the major part of the freight.

Ports	Km.	Wharves, factories, etc.
Charenton (Seine confluence)	0	Wharves
St Maur (St Maurice Derivation C.)	4	Turning basin
Jainville-le-Pont	5	Wharves. Tunnel to avoid loop of river
Nogent-sur-Marne	8	Wharves
Vaires (private canal to Noisy)	18	Wharves
Lagny	25	Wharves with railway sidings. Coal storage
Chalifert (short-circuit canal)	33	Basin for 15 barges. Tunnel
Mareuil-les-Meaux	42	Connected with Ourcq C. by roller staircase. Public and private wharves serve rich agricultural area
La Ferté-sous-Jouarre	87	Railway sidings. Wharves. Scrap-iron centre (shipped to Thionville)
Château-Thierry	129	Railway connexions with Aisne valley. Wharves serving agricultural area
Series of small ports	130-171	Timber wharves
Dizy (Marne Lateral C.)	182	Wharves. Coal depot

35. *Marne Lateral Canal*

(a) Freycinet classification	Main
(b) Length	67 km.
(c) Depth	2.00 m.
(d) Locks	15 (F)
(e) Fixed bridges	42 (3.40 m.)
(f) Tunnels	None
(g) Traction	Electric tractor. Gravelled towpath
(h) Tonnage (1936)	2,187,000
(i) Barge journeys (1936)	8,906

The Lateral Canal keeps to the edge of the river valley along the right bank. It carries the main traffic beyond Epernay to Vitry-le-François, which is the main junction of the canal system of eastern and north-eastern France. It serves the agricultural interests of the densely populated valley, and brings building materials, coal and coke.

Ports	Km.	Wharves, factories, etc.
Dizy (R. Marne)	0	
Mareuil-sur-Ay	8	Boat-building yards. Wharves and turning basin
Condé-sur-Marne (Aisne-Marne C.)	19	Wharves and turning basin
Châlons-sur-Marne	23	Convergence of 7 Routes Nationales and 4 railway lines. Wharves serving textile and other industries, wine bottling, etc. Turning basin
Omey	71	Private and public wharves serving chalk pits and lime kilns
Villers	82	Wharves serving chalk quarries and cement works
Couvrot (0.12 M.m.t.)	83	
Louvières	84	Private wharves serving cement works
Vitry-le-François (Marne-Saône C. and Marne-Rhine C.)	87	Boat-building yards. Wharves

36. *Marne-Saône Canal*

(a) Freycinet classification	Main
(b) Length	224 km.
(c) Depth	2.20 m.
(d) Locks	114 (F)
(e) Fixed bridges	131 (F)
(f) Tunnels	Two: (i) a double tunnel 308 m. × F., (ii) 4820 × 8 m. (part of a narrow passage of 7330 m.)
(g) Traction	Horse and tractor. Metalled or gravelled towpath
(h) Tonnage (1936)	849,000
(i) Barge journeys (1936)	3,666

This canal continues the Marne Lateral Canal to Langres on the water-parting between the Seine and the Rhône basins, it then drops by a staircase of locks to the Saône valley at Maxilly in the Côte d'Or district. The crossing of the water-parting involves a narrow single-



track length of 7,330 m. which includes a tunnel of 4,820 m. There is also a short double tunnel north of Chaumont.

Pit-props from St Dizier, building stone from Gué, pig-iron and coal form the chief part of the freight.

Ports	Km.	Wharves, factories, etc.
Vitry-le-François (Marne-Rhine C. and Marne Lateral C.)	0	Wharves. Repair yards
Frignicourt	2	Private wharves serving cement works
Hœricourt (Wassy branch)	26	Wharves
St Dizier	30	Sidings on Est railway Repair yards. Public and private wharves serving power station, ships, pit-props to the north-east
Gué	37	Railway sidings. Wharves
Joinville	62	Wharves serving variety of small metallurgical works
Condes	106	Double tunnel
Chaumont-en-Bassigny	109	Public and private wharves serving agricultural centre and power station
Langres (on spur above valley)	149	Road and rail centre
Maxilly	223	Railway sidings. Wharves
Heuilly-sur-Saône (R. Saône)	224	Wharves

### *Wassy Branch of the Marne-Saône Canal*

(a) Freycinet classification	Main
(b) Length	23 km.
(c) Depth	2.10 m.
(d) Locks	8 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Horse. Paved towpath
(h) Tonnage (1936)	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal

This branch supplies the isolated metallurgical district of Wassy-Brousseval, which, like all the scattered metallurgical industries on the edge of the Paris Basin, was based originally on local iron-ore mined in ferruginous sands and clays, but now depends on imported pig-iron and steel from Lorraine.

### *37. River Yonne*

(a) Freycinet classification	Main
(b) Length	108 km.
(c) Depth	2.00 m.
(d) Locks	26 (F)
(e) Fixed bridges	29 (F)
(f) Tunnels	None
(g) Traction	Horse, tug and tractor; sunken towing chain in addition on lower section. Metalled towpath
(h) Tonnage (1936)	104,000
(i) Barge journeys (1936)	5,064

The Yonne differs in many respects from the other tributaries of the Seine. With its tributary, the Armançon, it drains the highland of the Morvan that projects northwards from the Central Massif. It has a considerable catchment area of impermeable rocks, over which there is heavy rainfall with a rapid run-off which produces floods in the middle reaches of the Seine. It is navigable from Auxerre, where the Nivernais Canal begins, to its confluence with the Seine at Montereau. The river is rectified in places by a number of derivation canals which cut off the loops.

The upper Yonne, together with the Burgundy and Nivernais Canals, serves a link between the three areas of Paris, the central industrial area and the Saône valley; but the through-traffic is small, and the main function is the transport of timber, particularly pit-props. Timber is floated down the last 20 km. of the non-navigable course to Auxerre, and also from the wooded country of the upper Armançon down the Burgundy Canal to Laroche (Plate 89).

Ports	Km.	Wharves, factories, etc.
Montereau (R. Seine)	0	Wharves
Cannes (0·12 M.m.t.)	8	Wharves
Sens (0·14 M.m.t.)	40	1,000 cu.m. of warehouses. Wharves of Pont-à-Mousson Foundry and smelting works. Sens-Troy line of Est Railway
Joigny	76	Local railway lines. Wharves
Laroche (Burgundy C.)	85	Wharves and basins
Auxerre (Nivernais C.)	108	Wharves serving tanneries

## EASTERN FRANCE

The main natural waterways of eastern France are the Alsatian section of the Rhine, and the Moselle, which drains the western slopes of the Vosges highlands with the help of its tributary the Meurthe.

The Moselle and its canals link the largest single ironfield in Europe, that of Lorraine, with the coalfields of the Sarre and north-east France, and have contributed greatly to the development of an industrial area which depends to a large extent on the long-distance carriage of coke and coal. The district is connected by the Marne-Rhine Canal with the waterways of the Paris Basin, and by the canalized Saône and the Rhône-Rhine Canal with the Rhône valley and the Mediterranean. The Alsatian Rhine is a single section of an international river, the lower parts of which belong to Germany and Holland; despite extensive regularization, it is still far from being



an ideal navigational river. Only the first small section of a French scheme for a lateral ship canal linking Basle and Strasbourg has as yet been realized.

### DETAILS OF THE WATERWAYS OF EASTERN FRANCE

#### 38. *River Moselle (i) (Upper Section)*

(a) Freycinet classification	Main
(b) Length	52 km.
(c) Depth	2.00 m.
(d) Locks	6 moveable weirs, 13 locks (38 m. long)
(e) Fixed bridges	43 (42 F, 1 3.46 m.)
(f) Tunnels	None
(g) Traction	Electric tractor. Unpaved towpath
(h) Tonnage (1936)	1,121,000
(i) Barge journeys (1936)	11,782

The Moselle is navigable only for a relatively small proportion of its course. Above Frouard it is classified as raftable, and is paralleled by sections of the southern branch of the Est and of the Marne-Rhine Canals. The two sections Frouard to Metz and Thionville to the frontier are canalized; the intermediate stretch is used in part by the Moselle Canal.

Two short branches lead from the main river near Ancy-sur-Moselle to the detached ironfield of Ars and Vaud.

Ports	Km.	Wharves, factories, etc.
Frouard (Rhine-Marne C.)	0	Large dock basin. Wharves serving smelting works, steel works and engineering works
Pompey (0.11 M.m.t.)	3	Private wharves serving cement works, smelting works, iron and steel works
Custines (Meurthe confluence)	4	Public wharves with railway sidings on Pompey-Nomeny Railway
Millery	7	Wharves serving power station
Pont-à-Mousson (0.21 M.m.t.)	19	Public wharves serving smelting works, iron pipe works and cement works
Ancy-sur-Moselle (branches to Metz, Ars and Vaud)	40-42	Wharves serving ironfield of Ars and Vaud
Argancy dam (Moselle C.)	52	

#### *River Moselle (ii) (Lower Section)*

(a) Freycinet classification	Secondary
(b) Length	28.6 km.
(c) Depth	Variable (below 2.00 m.)
(d) Locks	None
(e) Fixed bridges	4 (F)

(f) Tunnels	None
(g) Traction	None
(h) Tonnage (1936)	None
(i) Barge journeys (1936)	None

This section of the Moselle is not canalized and is little used for navigation. Over the frontier the river has cut deep meanders in the Rhine plateau and is equally useless.

### 39. *Moselle Canal*

(a) Freycinet classification	Main
(b) Length	30 km.
(c) Depth	2.60 m.
(d) Locks	4 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Electric tractor. Metalled towpath
(h) Tonnage (1936)	1,121,000
(i) Barge journeys (1936)	5,686

This was opened in August 1932. It was constructed to link the industrial area of Metz-Thionville more closely with French interests. It joins the navigable Moselle above Metz and passes round the town. Below Metz vessels use the Moselle itself for 8 km. to Argancy dam; this is designed to regulate the water level and completely blocks the river to traffic. Here the canal leaves the river for about 10 km. and follows the Orne for 4 km. to Uckange; thence for about 5 km. the engineers had to use the bed of the river for lack of space, and a masonry dam separates river and canal. It has been proposed to make the Metz-Thionville ironfield completely independent of German coke and German markets by the construction of a Moselle-Aisne Canal which would make possible the direct passage of coal and coke from the north-east to Lorraine.

Ports	Km.	Wharves, factories, etc.
Metz (0.35 M.m.t.) (R. Moselle)	0	See (38)
Commencement of branch to Hagondange (0.36 M.m.t.)	15	
Richemont (short derivation via R. Orne to Uckange) (0.29 M.m.t.)	21	Private wharves serving Rombas steel works
Novéant (0.27 M.m.t.)	24	
Port de la Fensch	27	Public and private wharves serving iron and steel works
Beauregard	29	Private wharves serving iron and steel works
Thionville-Beaure- gard (0.20 M.m.t.)	30	Public and private wharves serving iron and steel works



40. *River Chiers*

(a) Freycinet classification	Secondary
(b) Length	35 km.
(c) Depth	Variable (below 2.00 m.)
(d) Locks	None
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Not stated
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

The river is classed as navigable for 35 km. from its confluence with the Meuse to La Ferté but carries no traffic of importance.

41. *Est Canal (Southern Branch)*

(a) Freycinet classification	Main
(b) Length	147 km.
(c) Depth	2.20 m.
(d) Locks	94 (F)
(e) Fixed bridges	89 (F)
(f) Tunnels	None
(g) Traction	Horse and tractor. Paved towpath
(h) Tonnage (1936)	2,951,000
(i) Barge journeys (1936)	12,035

This canal forms one of the chief service lines to the Lorraine ironfield, a function which it shares, however, with the Marne-Rhine Canal and with the canalized Moselle; it actually uses the Marne-Rhine Canal for 20 km. between Troussey and Toul.

Starting from the Port de la Vacherie, 2 km. above Toul on the Marne-Rhine Canal, it crosses the Oolitic limestone ridge of the Côte de Moselle by the Toul Gap, to Messein on the southern Lorraine ironfield. For about 24 km. from Messein it runs along the Moselle valley, and then crosses the forested water-parting between the Moselle and the Saône in the Mont Faucilles. Using the Madon valley, it drops to the Saône at Corre, at 223 m. above sea level.

Ports	Km.	Wharves, factories, etc.
Corre (R. Saône)	0	
Selles	8	Boat-building yards
Bouzy	54	Feeder reservoir with electrical pumping installation
Golbey (Epinal branch)	64	(Epinal textile industries)
Châtel-Nomexy	76	Wharves serving saw mills. Est Railway sidings. Coal and gas-coke depot
Haute-Flavigny	103	Wharves serving textile mills
Richardmenil	117	Private wharves serving sand quarries
Messein	119	Turning basin. Wharves serving iron ore quarries and iron and steel works
Neuves-Maisons (0.29 M.m.t.) (Nancy branch)	122	Extensive wharves serving sand and gravel quarries, iron mines, and iron and steel works
Sexey-aux-Forges	125	Public and private wharves serving iron mines, and iron and steel works
Toul (Rhine-Marne C.)	147	Port Vauban. Extensive wharves. Turning basins. Repair yards

*Branches of the Est Canal (Southern Branch)*

	(i) Nancy branch	(ii) Epinal branch
(a) Freycinet classification	Main	Main
(b) Length	10 km.	3 km.
(c) Depth	2.50 m.	2.20 m.
(d) Locks	18 (F)	None
(e) Fixed bridges	9 (F)	None
(f) Tunnels	None	None
(g) Traction	Horse and tractor. Paved towpath	Horse and tractor. Paved towpath
(h) Tonnage (1936)	768,000	Not stated
(i) Barge journeys (1936)	3,165	Not stated

From Neuves-Maisons near Messein a 10 km. branch runs over the water-parting to the Marne-Rhine Canal near Nancy, thus completing the circle of navigation round the Forêt de Haye. Another short branch runs south along the upper Moselle valley to Epinal.

42. *Est Canal (Northern Branch)*

(a) Freycinet classification	Main
(b) Length	272 km.
(c) Depth	2.20 m.
(d) Locks	59 (F)
(e) Fixed bridges	125 (F) and 2 others 3.40 and 3.50 m.
(f) Tunnels	Four: (1) $50 \times 6.00 \times 3.60$ m. (2) $45 \times 6.00 \times 3.60$ m. (3) $224 \times 5.95 \times 3.60$ m. (4) $565 \times 5.80 \times 3.60$ m.
(g) Traction	Horse, tractor and tug
(h) Tonnage (1936)	2,245,000
(i) Barge journeys (1936)	9,177

The catchment area of the Meuse has been reduced owing to the capture of its headstreams by the more active Moselle; and as a result the water supply of the Meuse is restricted. The valley is almost continuously enclosed between high limestone walls; the canal therefore utilizes the bed of the Meuse from its junction with the Marne-Rhine Canal at Troussey to the Belgian frontier near Givet. The river bed has been deepened and straightened; there are four tunnels to avoid natural difficulties.

The northern and southern branches of the Est Canal serve the great iron district south of Nancy, from which iron ore and pig-iron are sent to the Sarre, to Strasbourg and to Lyons. Coal is the main cargo moving south from the Sarre or from the Ruhr via Strasbourg. Pit-props, lime, building stone and wool are also important cargoes.



Ports	Km.	Wharves, factories, etc.
Troussey (Marne-Rhine C.)	0	
Commercy	10	Wharves shipping building stone
Les Kœur	22	Tunnel
Genicourt	51	Wharves shipping pit-props and stone
Haudainville	62	Wharves serving lime kilns
Verdun	68	Tunnel under fortifications. Port St Paul
Neuville	85	Wharves. Basin for 32 barges
Sivry	98	Wharves. Basin for 20 barges
Sedan	165	Port Maury. Public wharves
Villette	168	Private wharves serving steel works and woollen mills
Pont-à-bar (Ardennes C.)	176	Wharves
Charleville	192	Wharves serving iron and steel works. Coal depot
Revin	233	Tunnel. Wharves
Montigny	255	Wharves. Scrap iron depot
Ham	264	Tunnel
Givet	268	Wharves
(0.19 M.m.t.)		
Belgian frontier	274	

#### 43. *River Semoy*

(a) Freycinet classification	Secondary
(b) Length	18 km.
(c) Depth	Variable (below 2.00 m.)
(d) Locks	None
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Horse. Unpaved towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

The Semoy flows west from Belgium to join the Meuse at Mont-hermé. Of the 23 km. within France 18 km. are classed as navigable, but actually the waterway is used only to a limited extent by small barques.

#### 44. *River Sambre*

(a) Freycinet classification	Main. (N.B. This river is represented as second-class on official French maps; its dimensions entitle it to be considered of main category.)
(b) Length	54 km. (in France)
(c) Depth	2.00 m.
(d) Locks	9 (F)
(e) Fixed bridges	31 (3.35 m.)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath
(h) Tonnage (1936)	855,000
(i) Barge journeys (1936)	3,321

The river is canalized from its confluence with the Meuse at Namur in Belgium to Landrecies where it joins the Sambre-Oise Canal. It serves the important metallurgical district of Maubeuge, which is largely dependent upon the Mons-Charleroi Belgian coalfield. Apart from considerable amounts of coal in transit, the chief articles carried on the canal are sand, sandstone, iron and timber. There are timber ports all along the canal supplying pit-props to the coalfield and material for local barge builders.

Ports	Km.	Wharves, factories, etc.
Landrecies (Sambre-Oise C.)	0	Turning basin. Wharves serving marble quarries at Rocq, marble works of Jeumont and Marpent, and pottery works
Assevent	9	Civil and military airports
Aulnoye	17	Wharves serving great industrial area
Hautmont (0.10 M.m.t.)	34	Succession of private industrial wharves serving metallurgical district of Maubeuge, flour mills, machine tool works, railway work shop, power station, gas works, munition works, breweries and distilleries, etc.
Maubeuge	41	
Bouissois	47	Private wharves serving glass and chemical works. Nord Railway sidings
Marpent	51	Private wharves serving forges, foundries, engineering works and potteries
Jeumont	53	Wharves serving rolling mills and foundries, steel works, power stations, and gas works. Railway sidings
Belgian frontier	54	

#### 45. *Sambre-Oise Canal*

(a) Freycinet classification	Main
(b) Length	67 km.
(c) Depth	2.00 m.
(d) Locks	38 (F) (except width 5.10 m.)
(e) Fixed bridges	33 (F)
(f) Tunnels	None
(g) Traction	Tractor to Etreux, horse between Etreux and Foy. Metalled towpath
(h) Tonnage (1936)	1,193,000
(i) Barge journeys (1936)	4,620

The canal connects the coalfield of Mons-Charleroi with the Seine waterway system. It starts from Landrecies on the upper Sambre in the department of Nord, crosses the chalk divide in the district of Cambrésis, and then drops by a succession of locks to the Oise valley, sending off the La Fère branch to the St Quentin Canal.



Ports	Km.	Wharves, factories, etc.
Landrecies (R. Sambre)	0	Turning basin. Public and private wharves serving pottery factories
Catillon	9	Sidings connected with Cambrésis Railway (narrow gauge). Public and private wharves
Cadencourt	31	Public and private wharves serving brick works. Dock for 8 barges. Railway sidings
Origny (0·21 M.m.t.)	44	Public and private wharves serving cement works and distillery. Turning basin
Mézières-sur-Oise	53	Public wharves. Railway sidings
Beautor	66	Public and private wharves
(0·10 M.m.t.)		
Fargniers (La Fère branch)	67	

### *La Fère Branch of the Sambre-Oise Canal*

(a) Freycinet classification	Main
(b) Length	4 km.
(c) Depth	2·00 m.
(d) Locks	None
(e) Fixed bridges	4 (F)
(f) Tunnels	None
(g) Traction	Tractor. Metalled towpath
(h) Tonnage (1936)	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal

The La Fère branch which connects the St Quentin and Sambre-Oise Canals serves the steel works and rolling mills of Beautor and brings coal to the Nord Electrical Co.

### 46. *River Rhine*

The Alsatian Rhine may be conveniently divided into sections above and below Strasbourg.

	Section (i) Lauterbourg to Strasbourg	Section (ii) Strasbourg to Basle
(a) Freycinet classification	Main	Main
(b) Length	56·64 km.	127·5 km.
(c) Depth	1·40 m. (min.), 2·50 m. (mean)	0·90 m. (min.), 2·00 m. (mean)
(d) Locks	None	1 (F)
(e) Fixed bridges	1 (F)	5 (3·50 m.)
(f) Tunnels	None	None
(g) Traction	Tug. Paved towpath	Tug. Paved towpath
(h) Tonnage (1936)	With section (ii) 1,452,000	Included in section (i)
(i) Barge journeys (1936)	With section (ii) 15,000	Included in section (i)

For 184 km. the eastern frontier of France follows the Rhine. Above this section the Rhine is in Swiss territory, below it the river flows through western Germany and then reaches the sea through Holland. Thus the French section is only one part of an international

highway. No fewer than 105 treaties, conventions and agreements concerning the navigation of the Rhine were drawn up between 1648 and 1919. Until 1815, Rhine traffic was severely handicapped by the heavy tolls exacted at successive points along its banks. At the Congress of Vienna, inland waterways traversing or bounding several countries were declared to be international, and as such were to be open to all states, riparian or otherwise, subject to reasonable tolls. In 1868 the Convention of Mannheim set up a Central Commission to control navigation, on which was a representative of France, Holland and the four German states of Baden, Bavaria, Hesse and Prussia. In 1871 Germany obtained possession of both banks and France ceased to be a riparian state. The Treaty of Versailles, however, altered the balance of representation substantially in favour of France; Great Britain and Italy were also given representation. The Treaty allowed France to take water from the river and to execute any necessary works, subject to non-interference with navigation.

The river has four geographical sections: the Alpine section, the Rift Valley section in Alsace, the Rhenish Highland or Rhine Plateau section and the Delta section. It has an inexhaustible water storage in the snow-fields, glaciers and lakes of the Alpine section. Its regime, however, is not without considerable disadvantages for navigation. In winter the upper sources are frozen and the volume of water in the middle and lower river becomes low. When winter ends, floating ice comes down and constitutes a great danger to navigation. In spring and early summer the Alpine sluice gates are fully opened and the supply lower down becomes excessive, especially as spring and summer rainstorms add their quota. In late summer and early autumn the Alpine supply is at a minimum and summer drought makes itself felt. The river receives no major tributary either from the Black Forest or the Vosges above Strasbourg. The Vosges streams are all intercepted by the tributary Ill which flows parallel to the Rhine and does not make confluence till it reaches a point below the port of Strasbourg; on the east bank the Neckar only joins at Mannheim.

Another consequence of the Alpine origin of much of the Rhine waters is the enormous amount of detritus carried down during flood. The river has never been able to cope with the vast quantities of stones, gravel and sand that the swirling waters bring down every year to the plain. Gravel banks are continuously being built up, destroyed, and re-made lower down. The braided course of the river



in the Rift Valley is evidence of this work in the past. The maze of channels separated by wooded islands might suggest a gentle, sluggish course like that of the Saône, but in reality the Rhine is still torrential in Alsace and the river swirls along at a great pace. During the early nineteenth century, the bulk of the stream was forced into a middle channel, leaving innumerable backwaters, cut-offs, ox-bows and side channels to testify to former conditions.

Notwithstanding these natural difficulties the Rhine has been used for navigation for many centuries. Small boats used to come up by sail or were towed up. But it took a hundred men to tow a small barge against the current, and horses could not be satisfactorily employed on account of the irregular and uncertain state of the banks. Effective regulation works were not begun until the nineteenth century.

The straightening of the channel, although adding to its scour and depth, also added considerably to the swiftness of an already rapid current, so that traffic in the upper reaches became well-nigh impossible until the advent of powerful steam-propelled craft. And even so the dangers and difficulties of navigation are great, except at medium water, and at all times skilled pilotage is necessary. A diked and regulated channel exists for the whole length of the Rift Valley Rhine, but it is only with the aid of powerful tugs that the upstream passage can be made. Conditions are by no means always satisfactory below Strasbourg. Gravel banks shift and change their shape during every period of high water. Maintenance and marking of the channel is costly and difficult, and the frequent periods of excessively high or low water sometimes prohibit navigation altogether until these abnormal conditions disappear.

*The Growth of Strasbourg.* The shortening of the navigable channel did not ensure a regular depth; dredging, however, had secured a more or less reliable depth of 2 m. up to Mannheim by 1914. This made Mannheim the effective head of navigation and the port profited greatly, improving its equipment and railway communications till its annual traffic reached 10 million metric tons per annum. To be at the head of large-scale navigation is of such immense advantage to a port that even before 1914 the ambition of the merchants, industrialists and shippers of Strasbourg was to wrest that advantage from Mannheim by the regularization of the Rhine between it and their own port. Alsace under German rule was insistent in her demands for a continuation of the river works up to Strasbourg, having failed in a demand for a canal from Strasbourg

to Ludwigshafen. At last in 1892 the Bassin de Commerce and the Port d'Austerlitz were opened. Hitherto Strasbourg had been essentially a canal port, situated at the junction of the River Ill and the Marne-Rhine and Rhône-Rhine Canals (see pp. 410-13); it now became a Rhine port at the head of effective navigation. Further developments continued between 1907 and 1925. The Ill, hitherto the only approach to the canal port, was supplemented by two junction canals leading directly from the new river port (Fig. 117). Several new basins were constructed, including the petroleum port opened in 1927 (Plate 93). In 1928 a great extension scheme began, including

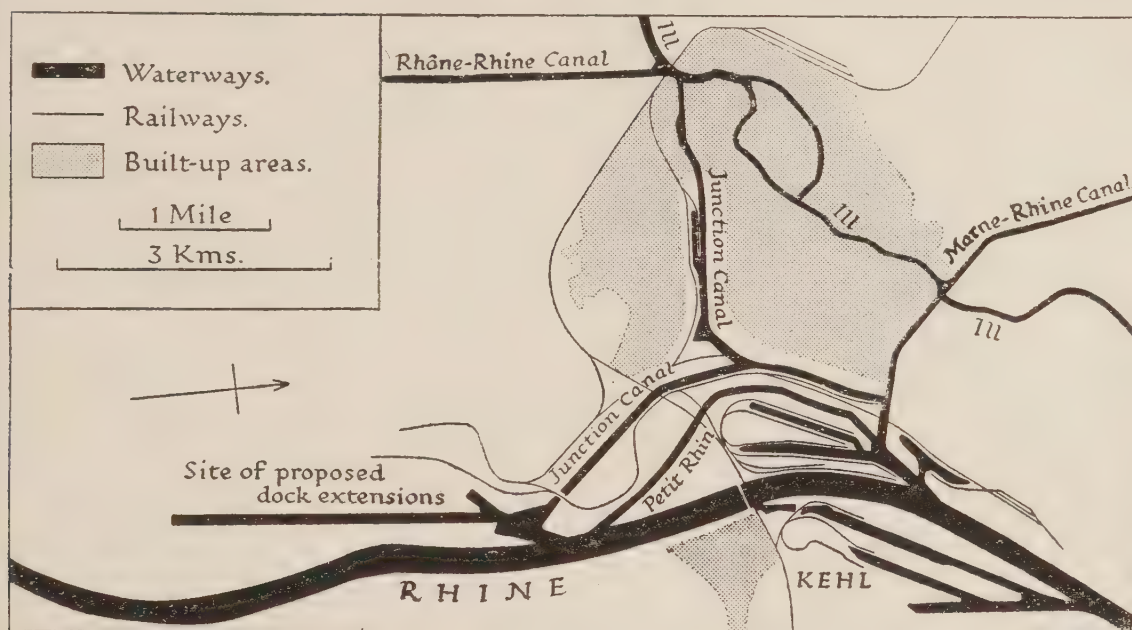


Fig. 117. The port of Strasbourg

Based on a map from *Atlas de France*, Plate 56 (Paris, 1936), with modifications from recent air photographs.

the construction of the 'Nouveau Port' above the Petit Rhin confluence, but it had not been completed by 1939.

With the development of the modern port came the growth of industry on a large scale. During the war of 1914-18 the Germans had found it convenient to coke coal for metallurgical purposes at Strasbourg and also to ship iron ore for Westphalia from that port. This activity was continued by the French; new activities were developed with the vast increase of the western hinterland after 1918. Large electrical installations are based on Rhine-borne coal. Grain is imported and milled on a large scale; the latest facilities include a silo constructed in 1935 and a large grainstore in 1936. Strasbourg now handles a greater volume of traffic than any other



French inland port. In 1936 this totalled nearly  $7\frac{1}{2}$  million metric tons, almost exactly divided between imports and exports. The movement of traffic in metric tons was as follows:

Route	Imports	Exports	Total by river	Total by canal
Rhine	1,924,822	3,204,360	5,129,182	—
Rhône-Rhine Canal	1,165,344	125,058	—	1,290,402
Marne-Rhine Canal	553,212	455,645	—	1,008,858
Totals	3,643,378	3,785,063	7,428,442	

*Note.* There is a discrepancy of 1 metric ton in the totals.

Ports	Km.	Wharves, factories, etc.
Lauterbourg (German frontier)	0	Wharves. Railway sidings
Strasbourg (7.43 M.m.t.) (Marne-Rhine C., Rhône-Rhine C.)	56	River and canal port. Wharves serve coke ovens, thermal electric plant, grain mills, general engineering industries, motor works, alimentary industries, etc. Railway centre
Brisach (branch to Rhône-Rhine C.)	126	
Kembs (Derivation C.)	174	Barrage
Huningue (locked junction with Huningue branch)	182	
Basle	184	

### *Grand Canal of Alsace*

It was a provision of the Treaty of Versailles that France might divert water from the Rhine, provided that facilities for the navigation on the main river should not thereby be reduced. Accordingly, in 1919, the *Société des Forces Motrices du Rhin* brought forward a scheme for a great lateral canal which should be fed from the Rhine by means of a canal at Kembs, 10 km. downstream from Basle. This was designed to obviate the necessity for improving the Rhine above Strasbourg, and at the same time to increase the contacts of the French waterways with the Rhine by way of that port. Both Germany and Switzerland strongly opposed the scheme, and agreed to improve the Rhine itself between Kehl and Lake Constance. France nevertheless decided to continue with the Alsace Canal. The first completed section was a 6 km. derivation across a loop near Kembs; it avoided the Istein Bar on the main river, a mass of rock over which the depth of water was steadily being reduced by the deepening of

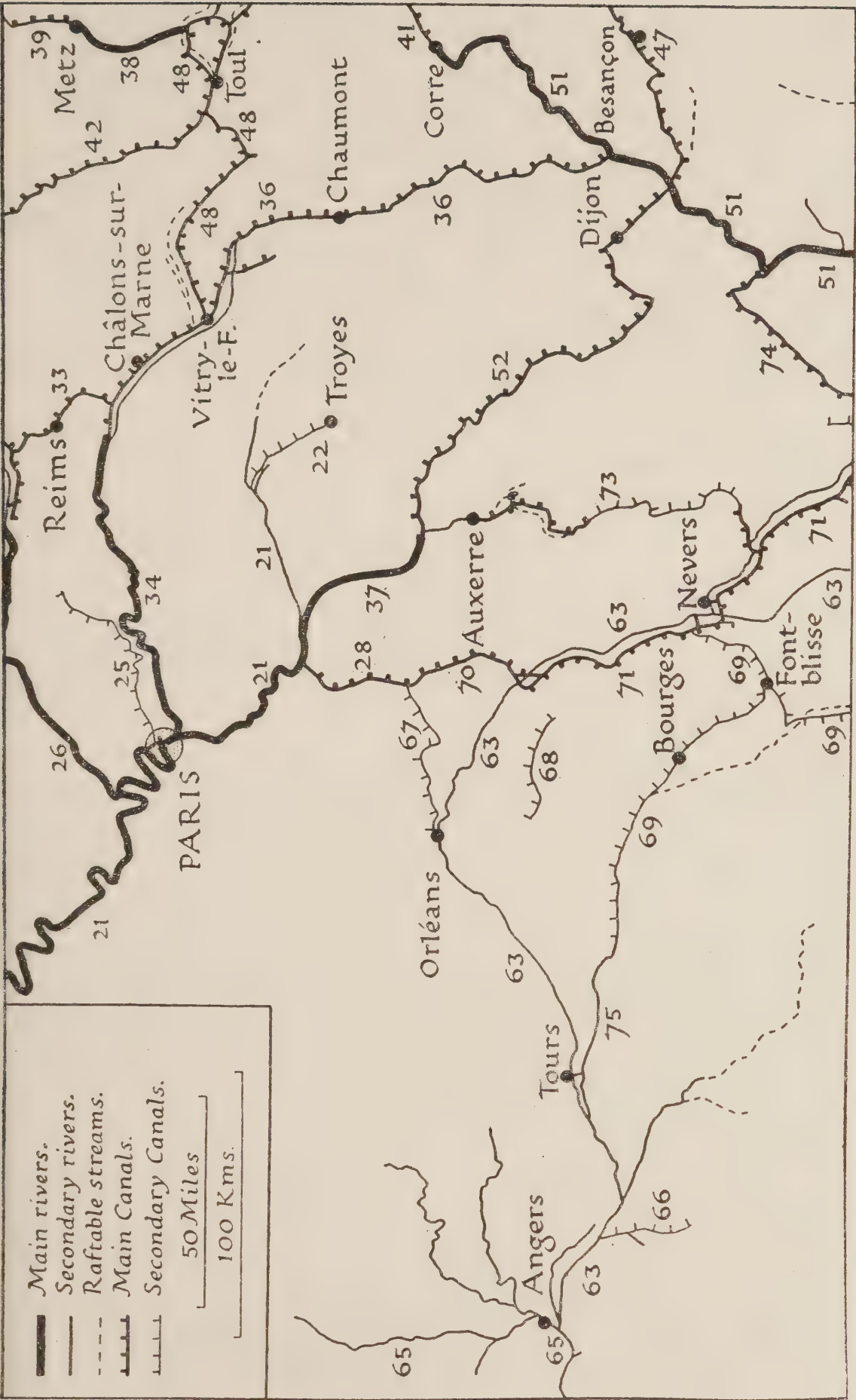


Fig. 118. Waterways of central France



the river bed, and which caused rapids negotiable only with extreme difficulty at certain times of the year. A barrage was constructed on the main river 500 m. below the offtake of the canal, to raise the level of the Rhine; this enabled both the Huningue Branch to the Rhône-Rhine Canal and the Kembs Derivation to receive an adequate supply of water. A large power station was built near the locks at the lower end of the Derivation; it is a producing unit for the national grid system. This section was completed in 1933, and was linked to the Rhine below the Istein Bar by a 1,150 m. canal, which will be suppressed when the next of the remaining seven sections of the Grand Canal is completed. No further progress has been made.

#### 47. *Rhône-Rhine Canal*

(a) Freycinet classification	Main
(b) Length	328 km.
(c) Depth	2.20 m. Section Bourogne to Strasbourg 2.10 m.
(d) Locks	166 (F)
(e) Fixed bridges	179 (F)
(f) Tunnels	2 (i) 180 × 6 × 4.45 m., (ii) 400 × 6.50 × 4.45 m.
(g) Traction	Horse or tractor to Mulhouse. Electric tractor from Mulhouse to Strasbourg. Metalled towpath
(h) Tonnage (1936)	1,951,000
(i) Barge journeys (1936)	9,420

The Rhône-Rhine Canal leaves the Saône at St Symphorien, a few kilometres above the junction of the Burgundy Canal, and follows a course of 324 m. to Strasbourg. Within the Saône basin it utilizes certain sections of the river Doubs between Besançon and Montbéliard. It then leaves the Doubs, runs between the Vosges and the northern Jura through the Burgundian Gate and crosses the former Franco-German frontier to the Ill valley. Subsequently, it passes to the east of the Ill (which flows parallel to the Rhine), along the edge of the fertile terraces that lie at the foot of the Vosges, and sends off several short branches. It then joins the river Ill which is canalized through Strasbourg (Figs. 116, 117).

Ports	Km.	Wharves, factories, etc.
St Symphorien (R. Saône)	0	Wharves. Basin for 8 barges. Basin for 4 barges
Choisey	15	Wharves. Basin for 8 barges
St Ylie	16	Basin for 20 barges
Besançon	74	Tunnel through citadel. Public and private wharves serving textile, steel and general engineering works, breweries and distilleries. Railway sidings

Colombier-Châtelot	148	Wharves. Basin for 12 barges
Montbéliard	165	Wharves serving textile industries, watch making, tool and machine making, and motor works. Basin for 50 barges
Erincourt (C. Montbéliard)	168	
Bourogne	176	Wharves. Basin for 20 barges
Mulhouse (0.27 M.m.t.)	221	Joined by short canal to new port of Mulhouse. Railway sidings. Wharves serving Alsace textile industries
Ile Napoléon (Huningue branch)	224	
Kunheim (Brisach branch)	261	
Artzenheim (Colmar branch)	264	
Erstein	300	Private wharves serving sugar refineries. Railway and tramway sidings
Strasbourg (R. Ill and Marne-Rhine C.)	312 to 324	See (46)

### *Branches of the Rhône-Rhine Canal*

Three short branches connect the main canal with neighbouring towns, and the Huningue branch connects it with the Rhine below Basle.

	(i) Montbéliard branch	(ii) Brisach branch
(a) Freycinet classification	Secondary	Secondary
(b) Length	17.4 km.	6.3 km.
(c) Depth	2.25 m.	1.90 m.
(d) Locks	12 (F)	1 (depth 1.90 m.)
(e) Fixed bridges	14 (F)	5 (F)
(f) Tunnels	None	None
(g) Traction	Tractor. Metalled towpath	Tug and tractor. Metalled towpath
(h) Tonnage (1936)	Included in return of Rhône-Rhine Canal	Included in return of Rhône-Rhine Canal
(i) Barge journeys (1936)	Included in return of Rhône-Rhine Canal	Included in return of Rhône-Rhine Canal
	(iii) Colmar branch	(iv) Huningue branch
(a) Freycinet classification	Secondary	Main
(b) Length	13 km.	28 km.
(c) Depth	2.20 m.	2.20 m.
(d) Locks	1 (F)	5 (F)
(e) Fixed bridges	13 (F)	14 (F)
(f) Tunnels	None	None
(g) Traction	Electric tractor Metalled towpath	Tug. Metalled towpath
(h) Tonnage (1936)	Included in return of Rhône-Rhine Canal	Included in return of Rhône-Rhine Canal
(i) Barge journeys (1936)	Included in return of Rhône-Rhine Canal	Included in return of Rhône-Rhine Canal



The Montbéliard Canal was originally intended to join the Rhône-Rhine Canal to the upper Saône at Conflandey, but only 17 km. have been finished and it is unlikely that it will be completed. The finished section was opened in 1923; it runs from the Rhône-Rhine Canal and ends at the Dijon-Belfort railway. The Huningue branch (Fig. 116) runs from the Ile Napoléon below Mulhouse to the Huningue Lock on the Rhine above the Kembs Barrage and Derivation Canal. It thus completes a canalized route from Basle to Strasbourg.

#### 48. *Marne-Rhine Canal*

(a) Freycinet classification	Main
(b) Length	317 km.
(c) Depth	2.20 m.
(d) Locks	178 (F)
(e) Fixed bridges	229 (F, except on Vosges Divide 3.35 m.)
(f) Tunnels	Five: (i) 4800 m., (ii) 4877 m., (iii) 867 m., (iv) 475 m., (v) 2307 m. Minimum clearance 4.10 m.
(g) Traction	Haulage by electric tractor. Metalled towpath
(h) Tonnage (1936)	5,142,000
(i) Barge journeys (1936)	20,958

The canal extends between the Marne at Vitry-le-François and Strasbourg. It is one of the most useful canals in France, for it brings Paris and the north-east into contact with the Lorraine and Sarre industrial districts, and provides for the latter an alternative outlet to the Rhine and Germany (Plate 92).

The route, although direct, is not an easy one, as it has to cross the barriers of the Jurassic escarpments and the Vosges. The canal does this by utilizing several river valleys and natural gaps, and in several cases tunnels are necessary to cross the water-parting.

Modern improvements in waterway and craft have greatly speeded up traffic, but many stretches are still liable to silting, and in dry years the water supply is apt to be insufficient. The canal is fed by the shallow lakes of Gondrexange whose supply is determined by rain and snow conditions in the Vosges. The canal crosses the most important industrial area of Lorraine, and its traffic amounts to about 8% of the total carried on French waterways. Pig-iron and steel are exported in large quantities. Lime, pit-props, basic slag, cement and chemical products are other important cargoes, while coal comes from Belgium, the Sarre and the Ruhr.



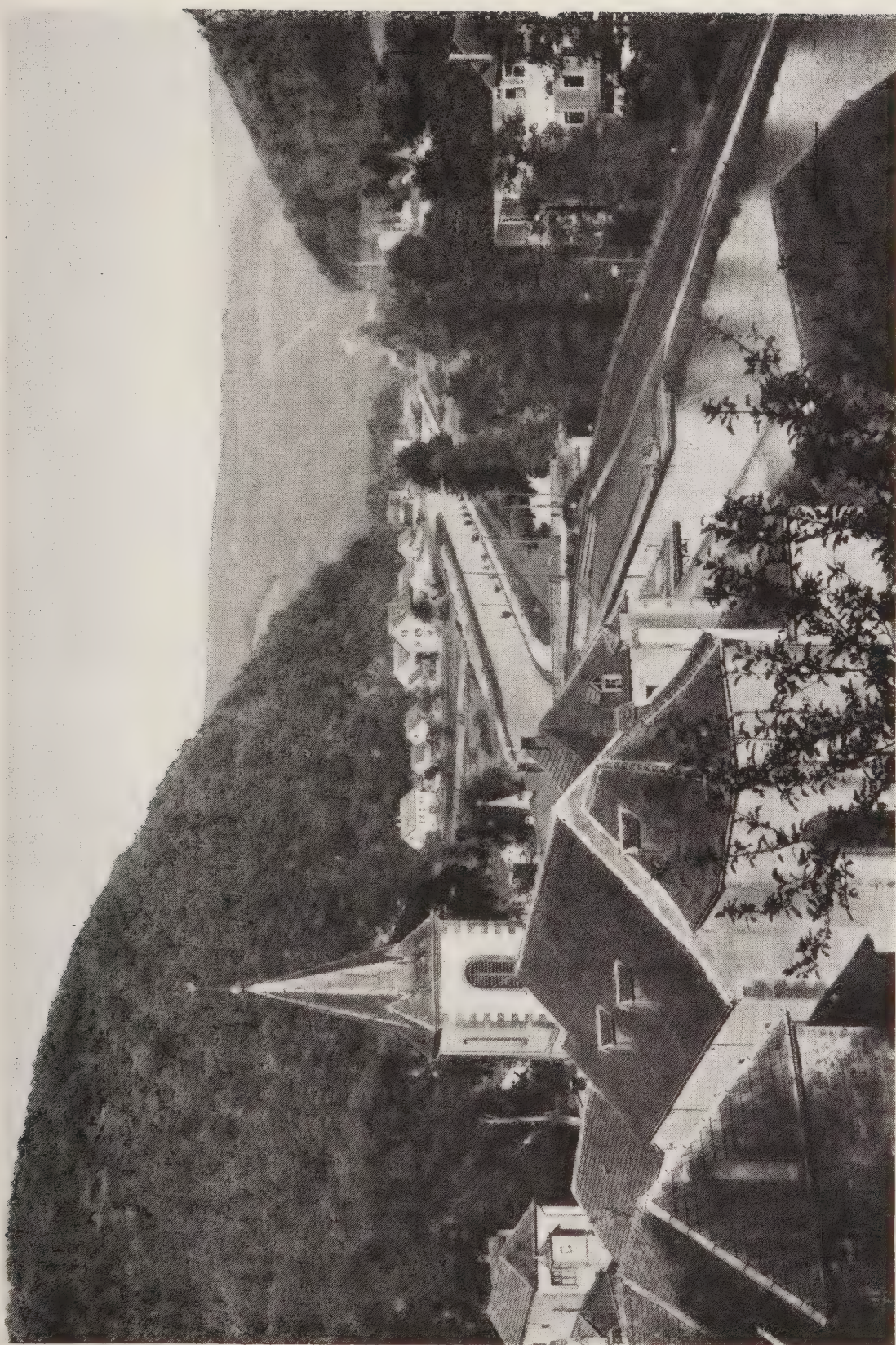


Plate 92. Marne-Rhine Canal at Lützelbourg

The canal winds between the thickly wooded ridges of the Vosges; it crosses the watershed through a series of natural gaps, but several tunnels and a large number of locks are necessary.



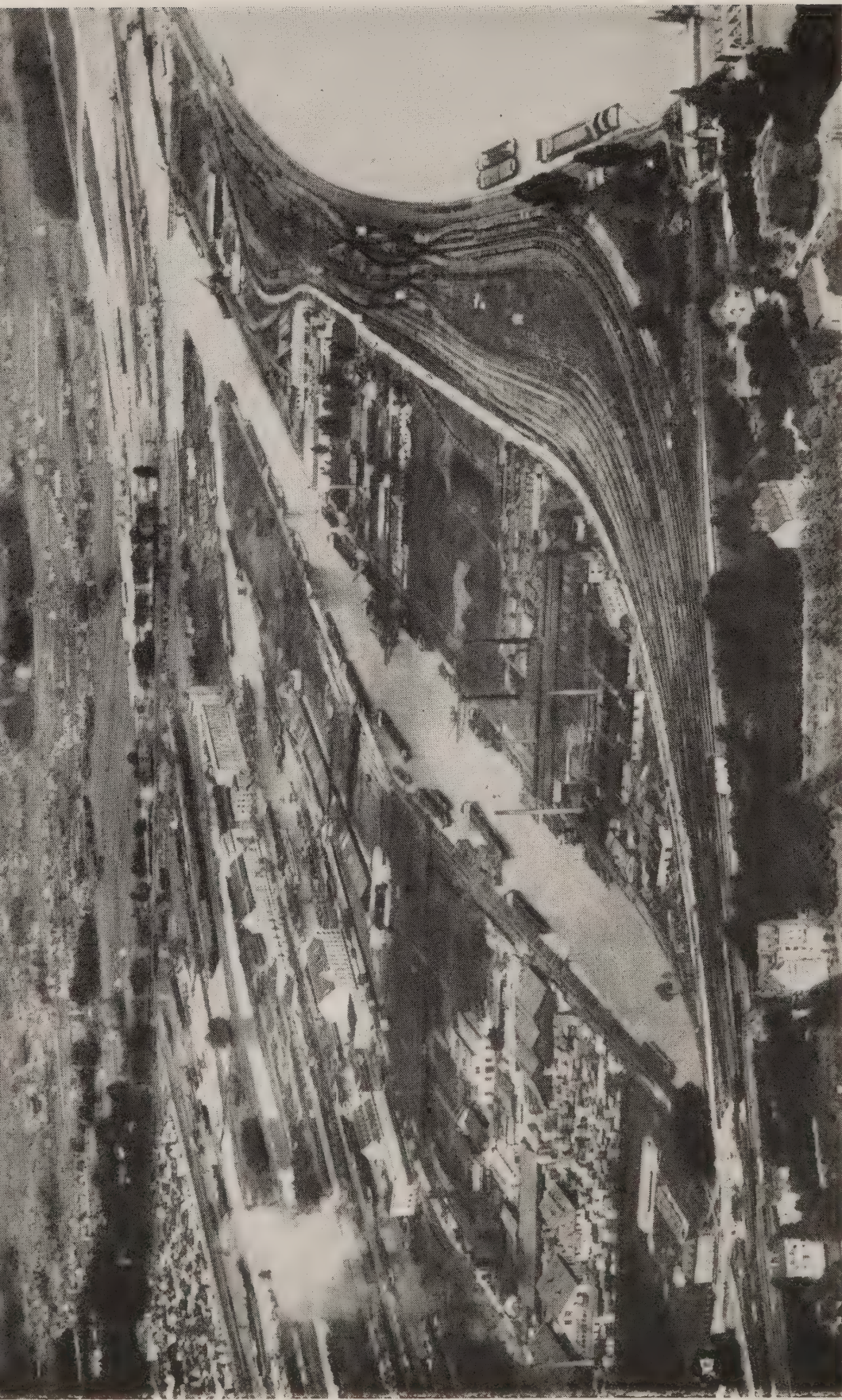


Plate 93. Strasbourg

On the right is the Rhine, with the port marshalling yard on the quay-side. In the centre is the Bassin de l'Industrie; farther to the left are the Bassin du Commerce, the Petit Rhin and the Bassin des Remparts. They open into the Avant-Port Nord, which has free access to the Rhine. The line of the Marne-Rhine Canal can be seen in front of the trees in the top left corner; it has a locked connexion with the avant-port. The storage tanks of the Bassin aux Pétroles are visible in the middle distance, with a large tank-barge at the quay. The ends of the two Rhine bridges which lead to Kehl are visible in the bottom right corner.



Ports	Km.	Wharves, factories, etc.
Vitry-le-François (Marne-Saône and Marne Lateral C.)	0	Wharves. Railway sidings
Bar-le-Duc	46	Sidings on Est Railway. Public and private wharves. Turning basin
Demange-aux-Eaux (Haudelaincourt branch)	85	Wharves. Turning basin
Mauvages	92	Tunnel. Wharves. Turning basin
Void	102	Wharves serving lime kilns
Troussey (Est C., North branch)	111	Wharves serving quarries
Pagny-sur-Meuse	116	Wharves serving cement works
Foug	122	Tunnel. Wharves. Turning basin
Toul (Est C., Southern branch)	129	Port de la France, Port de St Mansuy and Port de la Vacherie serving miscellaneous industries. Railway sidings
Villey-St Etienne (0.14 M.m.t.)	139	
Liverdun	143	Public and private wharves serving quarries and iron and steel works. Railway sidings. Turning basin and repair dock. Tunnel
Frouard (R. Moselle)	154	Public and private wharves serving Lor- raine ironfield and great iron and steel works. Port de Faubourg. Railway sidings
Phlin (0.24 M.m.t.)	153	Public and private works
Nancy (0.39 M.m.t.)	161	Extensive public and private wharves serving iron and steel works, textile factories, hat factories, glass works, electrical apparatus works and tanneries. Railway sidings
Maxeville (0.12 M.m.t.)	163	
Laneuveville (Nancy branch of Est C.)	168	Wharves serving chemical works, en- gineering works, and hat factories. Repair docks
Varangeville (0.47 M.m.t.)	177	Public and private wharves serving pottery and chemical works. Turning basin. Railway sidings
Dombasle (0.55 M.m.t.)	180	Wharves serving lime kilns, salt refineries and chemical works
Gondrexange (Sarre Colliery C.)	230	
Heming	234	Wharves serving cement works
Lützelbourg	253	
Saverne	259	
Strasbourg (7.43 M.m.t.)	310 to 314	See (46)

49. *River Sarre*

(a) Freycinet classification	Secondary
(b) Length	12 km. in France + 96 km. in Germany
(c) Depth	2.00 m.
(d) Locks	3 (F) French section
(e) Fixed bridges	7 (F) French section
(f) Tunnels	None
(g) Traction	Horse. Metalled towpath
(h) Tonnage (1936)	Included in return of Sarre Colliery C.
(i) Barge journeys (1936)	Included in return of Sarre Colliery C.



The French section of the Sarre is navigable only for about 9 km. from Sarreguemines to the frontier. It rises in the forested Vosges, collects its tributaries in the neighbourhood of Sarrebourg at the foot of the highland, and winds in an undecided course northwards across the clay plains of Lorraine, supplying water to the Colliery Canal. At Sarreguemines near the southern boundary of the Sarre Territory it is joined by the Colliery Canal, and becomes navigable. Then it is joined by the Blies and for 3 km. forms the boundary between France and the Sarre Territory.

#### 50. *Sarre Colliery Canal*

(a) Freycinet classification	Main
(b) Length	63 km.
(c) Depth	2.00 m.
(d) Locks	27 (F)
(e) Fixed bridges	38 (F)
(f) Tunnels	None
(g) Traction	Horse. Gravelled towpath
(h) Tonnage (1936)	1,211,000
(i) Barge journeys (1936)	4,657

The Sarre Colliery Canal starts from the Marne-Rhine Canal near Gondrexange and continues northwards to join the Sarre at Sarreguemines.

The main commodity moving south is of course coal from the Sarre, a traffic which has increased since 1918. The quantities of coke conveyed have also greatly increased, as recent technical improvements have enabled the formerly unsuitable coking coal of the Sarre to be used to produce a satisfactory metallurgical coke. The north-bound cargoes include iron ore, pig-iron, lime, sand and gravel.

Ports	Km.	Wharves, factories, etc.
Gondrexange (Marne-Rhine C.)	0	Public wharves
Remelfing (0.15 M.m.t.)	2	
Mittersheim (Loudrefing branch)	20	Public wharves
Sarralbe (0.21 M.m.t.)	22	
Rech (0.12 M.m.t.)	25	
Sarreguemines (R. Sarre)	63	Wharves

#### *Loudrefing Branch of the Sarre Colliery Canal*

(a) Freycinet classification	Main
(b) Length	4.1 km.
(c) Depth	2.00 m.
(d) Locks	None
(e) Fixed bridges	2 (F)
(f) Tunnels	None
(g) Traction	Horse. Paved towpath
(h) Tonnage (1936)	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal

A short branch leaves the main canal at Mittersheim, linking it to the manufacturing town of Loudrefing.

## SOUTH-EASTERN FRANCE

The most important waterways of south-eastern France comprise the north-south line of the Rhône-Saône system, together with the canals which have been developed in the region of the Rhône delta. The important Burgundy Canal, which links the Rhône-Saône and Seine systems, is also included (Figs. 119, 120).

### 51. *River Saône*

The river may conveniently be divided into four sections as follows:

	Section (i) Corre to Gray	Section (ii) Gray to St Jean-de-Losne
(a) Freycinet classification	Main	Main
(b) Length	99 km.	64 km.
(c) Depth	2.00 m. (min.), 2.10 m. (mean)	2.00 m.
(d) Locks	18 (F)	4 (F)
(e) Fixed bridges	42 (F but 3.52 m. at Bauley)	18 (F)
(f) Tunnels	None	1 (643 m. × F)
(g) Traction	Horse and tug. Partly natural, partly gravelled	Horse and tug. Partly natural, partly gravelled
(h) Tonnage (1936)	Total of four sections 3,512,000	Included in section (i)
(i) Barge journeys (1936)	Total of four sections 21,049	Included in section (i)
	Section (iii) St Jean- de-Losne to Verdun	Section (iv) Verdun to Mulatière
(a) Freycinet classification	Main	Main
(b) Length	44 km.	167 km.
(c) Depth	2.00 m. (min.), 2.20 m. (mean)	2.00 m.
(d) Locks	6 (F)	6 (F)
(e) Fixed bridges	45 (3.68 m.)	45 (3.68 m.)
(f) Tunnels	1 (681 m. × F)	None
(g) Traction	Horse and tug. Partly natural, partly gravelled	Horse and tug. 103 km. of towpath natural, 64 km. metalled
(h) Tonnage (1936)	Included in section (i)	Included in section (i)
(i) Barge journeys (1936)	Included in section (i)	Included in section (i)

The Saône is navigable and is canalized between Lyons and Corre, at the junction of the southern branch of the Est Canal, although the steeper tortuous section above Verdun (Petit Saône) is not used much.



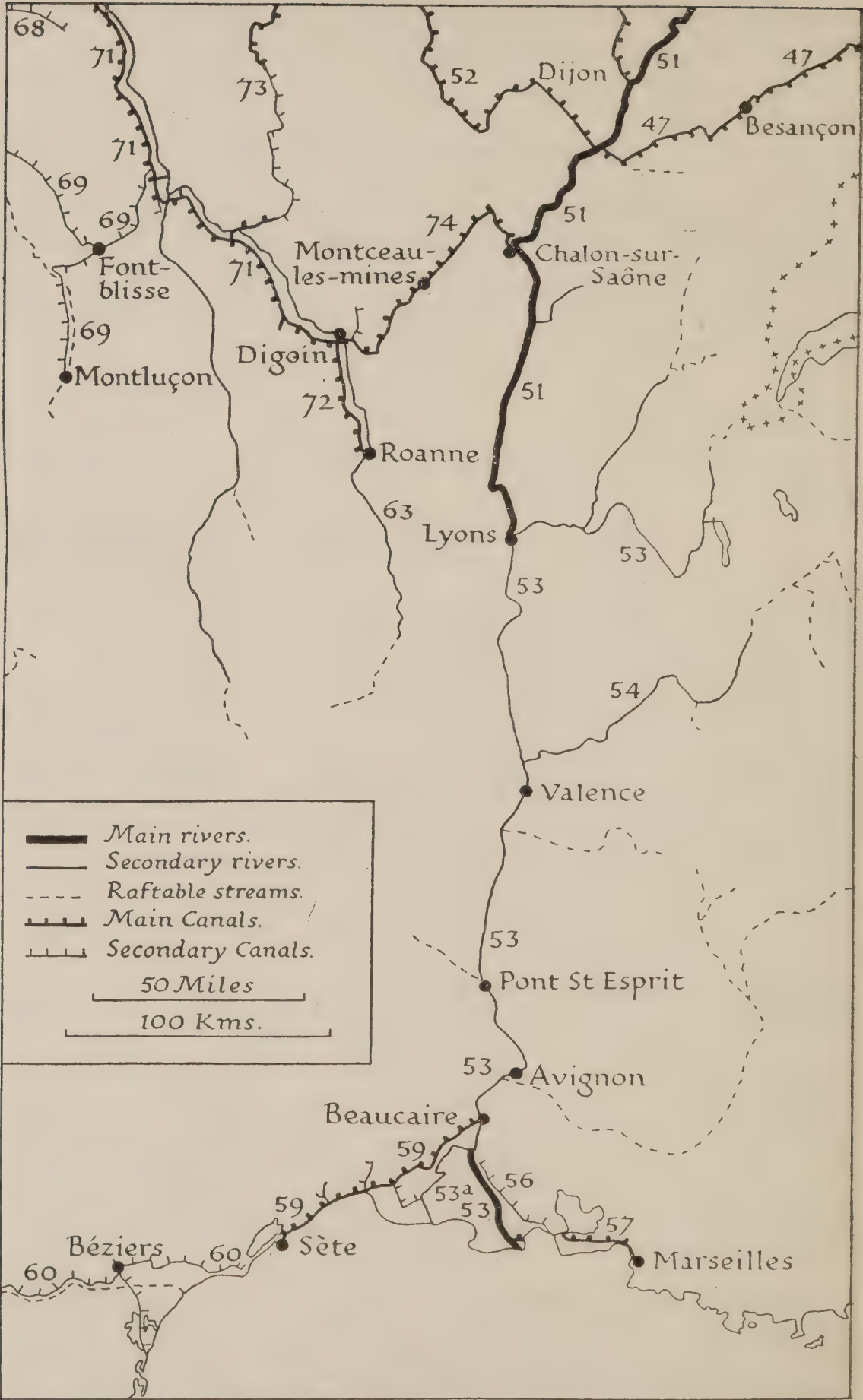


Fig. 119. Waterways of south-eastern France  
The waterways of the Rhône delta are shown on Fig. 120 on an enlarged scale.

It flows in the long enclosed plain of Burgundy, which stretches for some 200 km. between the highlands of the Jura to the east and the Côte-d'Or to the west. It draws its headwaters from the low divide which separates its basin from that of the Meuse in Lorraine, and a number of short swift streams bring to it the waters of the steep southern slopes of the Vosges. In the lowest part of the plain around Chalon streams from the Jura and the Central Massif converge upon it, but all have long courses across the plain and have time to deposit much of their silt before the confluence. The river brings a considerable volume to the Rhône, for rainfall is heavy in the Vosges and especially so on the high, west-facing slopes of the Jura, sometimes as much as 1,800 mm. per annum. The Doubs, its chief tributary, brings down much melt-water in spring, and the streams rise again with the heavy autumn and winter rains.

Four waterways, ranked officially as first class, converge in the neighbourhood of the St Jean-de-Losne on the lower Saône. None of these carries a very heavy traffic, but between them they contribute a considerable bulk to the Saône. At Chalon some of this traffic—largely coal, coke, iron and steel—leaves the Saône for the Le Creusot district, but most continues to the new port of Mâcon and to Lyons, which is the terminus of important traffic.

Lyons in 1936 was the eighth inland port of France. It has quays on the Rhône where constructional material, chiefly for river works, is unloaded. The main port lies within the city above the confluence of the Rhône and Saône on the right bank of the latter. It consists of a succession of quays of which Port Rambaud, belonging to the P.L.M. Railway, handles most traffic. Port Rambaud, which was opened in 1926, has 1,000 m. of frontage, and includes 250 m. length of petroleum wharves (Plate 94). There are coal yards capable of storing 30,000 metric tons, and warehouses covering an area of 16,000 sq.m.

The traffic handled by Port Rambaud increased so rapidly that by 1933 it was working to full capacity. In 1934 the Lyons Chamber of Commerce and the *Compagnie Nationale du Rhône* drew up a project for a new port; work commenced in 1935. Known as the Edouard Herriot Port, it is situated 3.5 km. below the Saône confluence on the left bank of the Rhône near the industrial suburbs of south-east Lyons. It consists of an oil dock and two general docks, each opening into a channel 90 m. wide which has free communication with the Rhône. By April 1938 the oil dock and dock No. 1, with a total quayage of 3.8 km., had been completed and were in use. The



construction of dock No. 2 has been deferred until the increasing trade of Lyons should warrant it. Apart from the public quays, most of the port space has been leased to manufacturers and merchants.

The traffic of the port of Lyons, which in 1936 totalled 1,228,000 metric tons, may be analysed as follows:

Route	Thousand metric tons	
	Exports	Imports
Saône	167	967
Rhône	73	21
Total	240	988

Ports	Km.	Wharves, factories, etc.
Lyons (1·23 M.m.t.) (R. Rhône)	0	Succession of quays serving great variety of industries.
Mâcon (0·12 M.m.t.)	80	Wharves. New port with modern equipment. P.L.M. railway sidings
Chalon-sur-Saône (0·35 M.m.t.) (Centre C.)	141	Public and private wharves. Railway sidings
Verdun (Doubs confluence)	166	Wharves
St Jean-de-Losne (0·10 M.m.t.) (Burgundy C.)	211	Wharves. Coal depot
St Symphorien (Rhône-Rhine C.)	215	Coal depot
Vonges	244	Private wharves serving munitions works
Heuilley (Marne- Saône C.)	249	Wharves
Gray	274	Wharves serving grain market. Est Railway connexion. Also local Haute-Saône-Gray Railway Co. Road convergence
Seveux-Savoieuse	299	Loop cut off by tunnel
St Albin	324	Loop cut off by tunnel
Scay-sur-Saône	327	Vesoul-Molay Railway. Wharves
Corre (Est C., Southern branch)	374	

## 52. *Burgundy Canal*

(a) Freycinet classification	Main
(b) Length	242 km.
(c) Depth	2·00 m.
(d) Locks	189 (F)
(e) Fixed bridges	152 (F) 2 (3·64 m.)
(f) Tunnels	1 (3,350 m. × 2·40 m. clearance)
(g) Traction	Tractor and horse. Metalled towpath
(h) Tonnage (1936)	797,000
(i) Barge journeys (1936)	4,447

The canal has more local than through-traffic, although it joins the Seine system with that of the Saône-Rhône. Leaving the Yonne just below the confluence of the Armançon, it follows the valley of the latter river and of one of its tributaries for over 150 km., climbing by means of locks and the tunnel at Pouilly-en-Auxois over the Côte-d'Or. It then drops by way of the Ouche valley to Dijon, and thence to the Saône at St Jean-de-Losne.

Quarries supply most of the raw material transported, together with cement and bricks. It also serves the small metallurgical industries of Auxerre and Montbard, and plays an important part in carrying pit-props to Béthune and the Nord generally. On the other side of the summit, it serves the great railway junction of Dijon, bringing coal from Liège and metals and building materials from Lorraine.

Ports	Km.	Wharves, factories, etc.
Laroche (R. Yonne)	0	Boat repair yards
Brienon	10	Boat-building yards. Wharves serving sugar refinery
St Florentin	19	Wharves and docks. Railway sidings (Est)
Montbard	102	Wharves serving tile and brick works, and iron and steel works
Pouilly-en-Auxois	155	Tunnel. Wharves serving tile works
Dijon (0.23 M.m.t.)	212	Railway junction. Modern port. Coal depot. Barge repairing yard. Alimentary industries
La Colombière	215	Wharves serving iron and steel works
Bretenières	223	Wharves serving distillery
Aiserey	232	Wharves serving sugar refinery
Brazey	237	Wharves serving distillery
St Usage	241	Wharves serving cement works and saw mills. Coal depot
St Jean-de-Losne (0.10 M.m.t.) (R. Saône)	242	Docks, wharves serving steel works. Railway sidings. Repair basin

### 53. *River Rhône*

The Rhône may be divided into three sections, namely, (i) from the limit of navigability at Le Parc to Lyons, (ii) from Lyons to Arles, and (iii) the delta.

	Section (i)	Section (ii)	Section (iii)
(a) Freycinet classification	Secondary	Secondary	Main
(b) Length	154 km.	287 km.	48 km.
(c) Depth	0.60 m. (min.), 1.00 m. (mean)	1.35 m. (min.), 1.60 m. (mean)	2.00 m.
(d) Locks	None	None	None
(e) Fixed bridges	24 (F)	34 (F)	None
(f) Tunnels	None	None	None



	Section (i)	Section (ii)	Section (iii)
(g) Traction	Horse. Unpaved towpath	Tug. Metalled towpath.	Tug. Metalled towpath.
(h) Tonnage (1936)	96,000	648,000 with section (iii)	
(i) Barge journeys (1936)	2,115	3,680 with section (iii)	

The Rhône is officially classed as a navigable river to within 33 km. of the Swiss frontier, that is to say, for a distance of 489 km. It is little used for through-traffic in spite of the fact that its course lies along the vital natural highway trenched between the great obstacles of the French Alps and the Central Massif, the chief means of communication between the Mediterranean and northern France, and that it bears more water to the sea than any other French river.

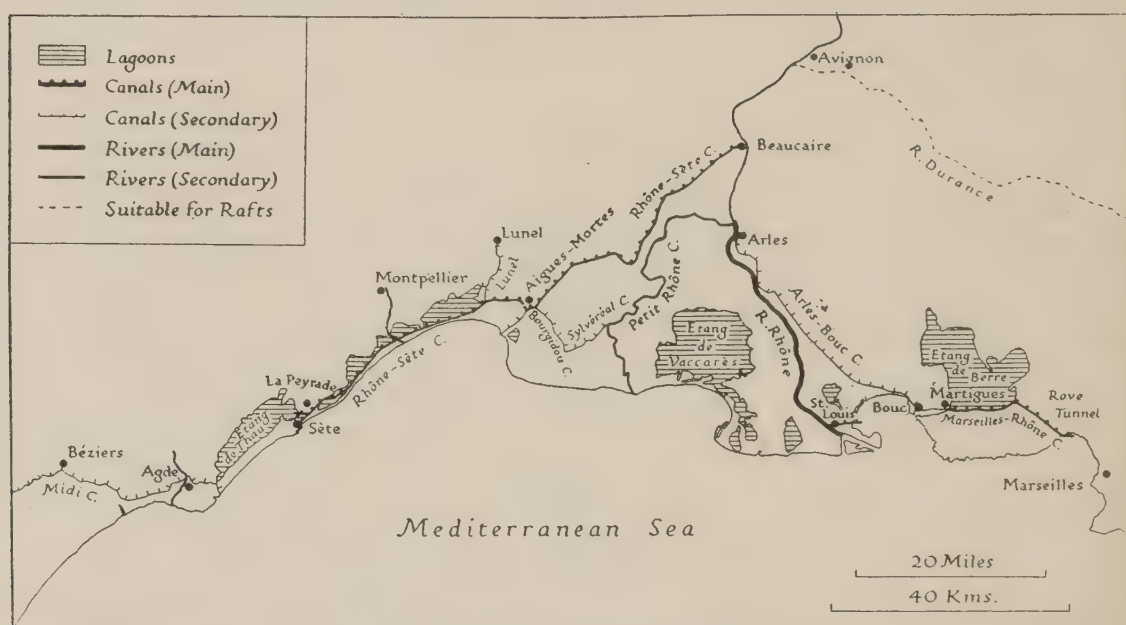


Fig. 120. Waterways of the Rhône delta

The small scale necessitated slight simplification in places, notably in the case of the Rhône-Sète Canal, which follows a diked channel through the *étangs*. (Compare Fig. 42.)

Reasons for this lack of utilization lie mainly in the nature of the river itself, which offers many difficulties to the engineer and to the navigator. In the first place the river is torrential from its glacial source to its confluence with the Saône at Lyons, in spite of the regulating effect of the Lake of Geneva. The fall in the first 48 km. below the lake is over 100 m. The gradient between Geneva and the Saône junction is very steep. Between Le Parc below Lake Geneva and Lyons the gradient is 1/1,000. Below Lyons the steepest gradient is between the confluence of the Isère and that of the Ardèche. Throughout the rest of its course until the head of the delta is reached the river alternately passes through deeply trenched, steep-sided

gorges with sudden alterations of gradient, and level, enclosed plains where heavy deposition of rock waste blocks the channel, dividing the stream into a network of watercourses and decreasing the navigable depth. Vast contributions of stones, gravel and silt are made to the stream by its Alpine tributaries—Isère, Durance, Drôme and others. Even the lesser heights of the Central Massif to the west send down loads of rock waste torn away by such torrents as the Ardèche after heavy rain or snow-melt.

To add to the very serious difficulties of the steep and irregular gradient, the seasonal flow of the river is very uneven. High water occurs in winter at the Saône junction, with a second maximum in spring due to snow-melt and cyclonic storms. After the junction of the Isère, the regime reflects Alpine influences and shows recurrence of early summer floods. On the whole the compensating effect of Saône and Rhône regimes would be beneficial except for the short-lived but violent irregularities due to the contributions of the tributaries from the Central Massif. In the lower reaches of the river high water results from the cyclonic autumn and winter rains of the western Mediterranean. Thus sudden rises may occur in the river at almost any season of the year.

The obstacles presented by the steep gradient and irregular regime of the river have made navigation much less important than might be expected. Only short-distance downstream traffic uses the upper section, from Le Parc to Lyons. Cargoes are chiefly stone from near Villebois, and gravel from just above Lyons. Above Lyons the river is only raftable. The normal tonnage carried is somewhere in the neighbourhood of 63,000 metric tons. There have been a number of schemes to improve the navigation of this section, including a proposal for a lateral canal, but many difficulties hinder this. In 1918 an alternative scheme was proposed for the regularization of the Rhône itself by a succession of derivations controlled by mobile barrages, serving to produce irrigation facilities and electric power as well as improving navigation. No action has been taken to put this scheme into effect.

From Lyons to the Mediterranean the river has an annual traffic of between 800,000 and a million metric tons. Navigation is dangerous, especially between Valence and Avignon, and skilled pilotage is essential to avoid chains and groins which are covered at high water.

In 1937 the Government authorized the *Compagnie Nationale du Rhône* to carry out the first part of a great scheme to provide new facilities for large barges between Marseilles and Central Europe.



The Lyons Chamber of Commerce however turned down a project put forward by Marseilles for a lateral canal from Lyons to connect with the enlarged Arles-Bouc and Marseilles-Rhône Canals. They declared instead in favour of regularizing the Rhône, and produced a ten-year scheme costing some 68 million francs, which included the development of river-ports. By 1939 some stretches had been deepened and experimental 'scouring walls' had been built to deal with silting.

There are also serious obstacles to the development of inland water transport along the Mediterranean coastlands, although the lagoons offer certain facilities. The continuous silting along the coasts of Languedoc is inimical to canal construction. For example, the main distributary of the Rhône from Arles to the sea at St Louis is badly hindered by silting, which after heavy floods wedges the lock gates. Yet efforts have been renewed from time to time to provide an adequate outlet for the Rhône navigation by a number of canals, which are chiefly diked and dredged channels through the lagoons; these are described below. In Provence development is associated with extensions of the port of Marseilles, and efforts to bring the port more directly into touch with its hinterland (see pp. 190-1).

Between Pont-St Esprit near the Ardèche confluence and Arles there is a regular service of tugs hauling the heavy *chalands*. These boats sometimes go right through by river and canal to Marseilles and Sète. Paddle-wheel tugs and motor barges are also used. These self-propelling boats must be capable of a speed of over 20 km. per hour against the current, and the barges carry a much smaller upstream load. The main cargoes carried downstream are agricultural produce, *vin ordinaire* for export, sand and gravel for river work, coal, and bauxite. The upstream cargoes include petroleum and mineral oils, olive oil and soap, fertilizers (chiefly phosphates from North Africa), pyrites, and Algerian wine.

Ports	Km.	Wharves, factories, etc.
Mediterranean Sea	0	
Port-St Louis-du-Rhône (St Louis C.)	8	Wharves
Arles (Arles-Bouc C.)	48	
Fourques (Petit Rhône confluence)	51	Wharves. P.L.M. railway sidings
Beaucaire (0.11 M.m.t.) (Rhône-Sète C.)	63	Wharves
Avignon (R. Durance confluence)	90	Wharves
Ardoise	117	Dock with P.L.M. railway sidings

Pont-St Esprit (R. Ardèche confluence)	128	Wharves
Valence	221	Wharves
Isère confluence	227	
Givors	316	Public wharves and basin. Railway sidings
Lyons (1·23 M.m.t.) (R. Saône confluence)	338	Port serves various industries (see (51))
Anthon (R. Ain confluence)	368	
Chanaz (Savières C.)	466	
Le Parc	489	

### *Petit Rhône*

(a) Freycinet classification	Secondary
(b) Length	58 km.
(c) Depth	0·60 m. (min.); 1·60 m. (mean)
(d) Locks	None
(e) Fixed bridges	5 (F)
(f) Tunnels	None
(g) Traction	Tug and horse. Unpaved towpath
(h) Tonnage (1936)	Included under sections (ii) and (iii) of R. Rhône
(i) Barge journeys (1936)	Included under sections (ii) and (iii) of R. Rhône

The *Petit Rhône* is the western distributary of the Rhône; it takes off above Arles and reaches the Mediterranean coast at Les Stes Maries. It is not an important waterway, for the annual traffic amounts only to about 1,000 metric tons, which consist chiefly of constructional materials for Rhône works from Beaucaire.

### 54. *River Isère*

(a) Freycinet classification	Secondary
(b) Length	154 km.
(c) Depth	(i) Section Aigue-Blanche to Chambéry, 0·50 m. (min.), 1·30 m. (mean); (ii) Chambéry to Grenoble, 0·50 m. (min.), 1·00 m. (mean); (iii) Grenoble to R. Rhône, 0·50 m. (min.), 1·50 m. (mean)
(d) Locks	None
(e) Fixed bridges	28 (3·00 m.)
(f) Tunnels	None
(g) Traction	Horse. Towpath unpaved and not continuous
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

The Isère is classed as a secondary waterway and has been canalized, but owing to the strength of the current and its irregular regime, the river is mainly used for generating hydro-electricity rather than for navigation.



55. *Savières Canal*

(a) Freycinet classification	Main
(b) Length	4 km.
(c) Depth	2.00 m.
(d) Locks	None
(e) Fixed bridges	2 (F)
(f) Tunnels	None
(g) Traction	Small steamer. Metalled towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

This short and unimportant canal links the Lac du Bourget with the Rhône at Chanaz.

56. *Arles-Bouc Canal*

(a) Freycinet classification	Secondary
(b) Length	47 km.
(c) Depth	1.85 m.
(d) Locks	3 (F, but depth 1.85 m.)
(e) Fixed bridges	1 (F)
(f) Tunnels	None
(g) Traction	Petrol or Diesel tractor. Unmetalled towpath
(h) Tonnage (1936)	50,000
(i) Barge journeys (1936)	710

The Arles-Bouc Canal forms a section of the waterway which connects Marseilles with the Rhône (Fig. 52), but although the maritime section through the lagoons has been developed on a large scale, the widening and deepening of this fluvial section has not yet been carried out except for a short reach between Port-de-Bouc and Fos-sur-Mer. This '*Tranchée de Bouc*' is 2,259 m. long, and its depth of 2.50 m. is intended to be that of the whole canal, which at present is 1.85 m. On completion, the Rhône *chalandes* will be able to go through to Marseilles. The merchants of Marseilles envisage a time when a ship canal will connect that port via a Rhône Lateral Canal with Lyons, but Lyons is against this scheme owing to the cost.

Barges from the Midi Canal frequently pass via the Rhône-Sète Canal through the Arles-Bouc Canal and thence to Marseilles (Fig. 120).

57. *Marseilles-Rhône Canal*

(a) Freycinet classification	Main
(b) Length	29.7 km.
(c) Depth	8.00 m.
(d) Locks	1 (F)
(e) Fixed bridges	Not stated
(f) Tunnels	One. Rove tunnel. 7.12 km. × 22 m. × 11.40 m.
(g) Traction	Metalled towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys 1936)	Not stated





Plate 94. A petroleum port at Lyons

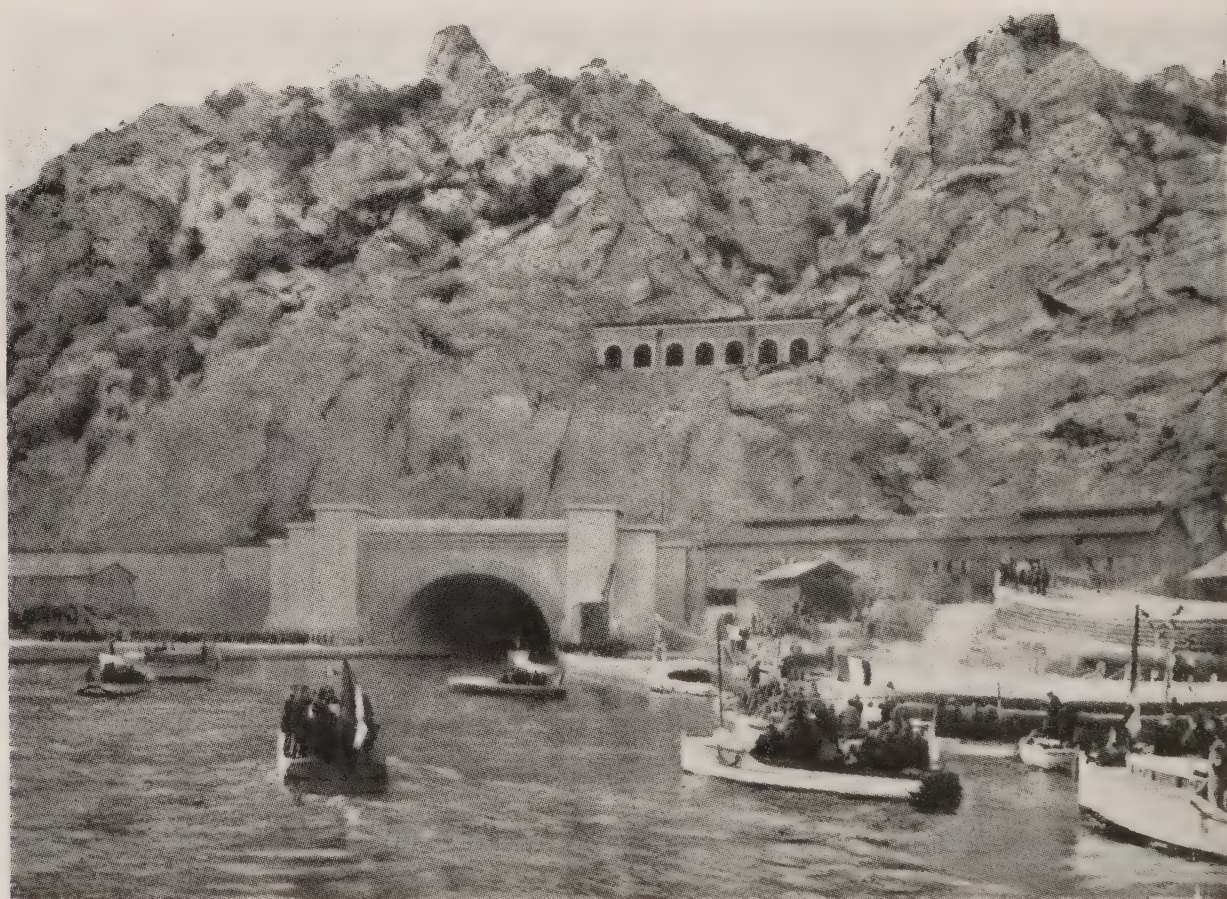
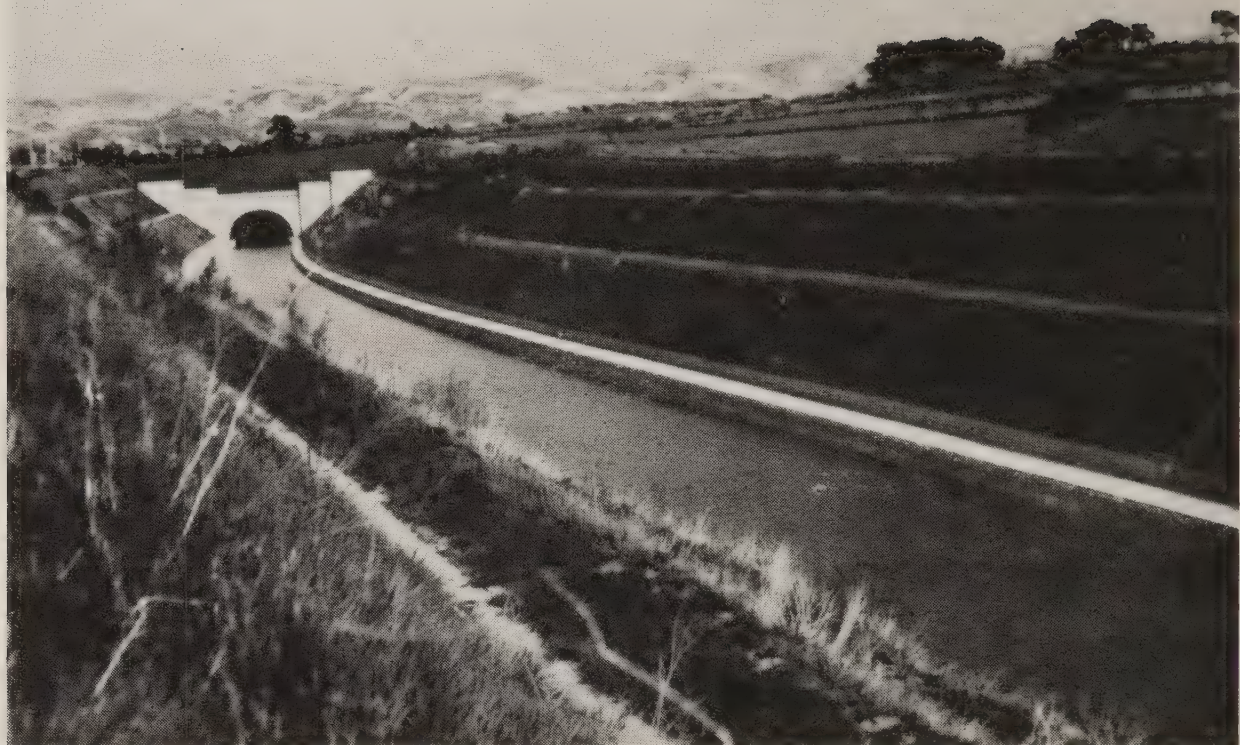
An extensive oil depot owned by one of the largest distributing firms in France—*Les Consommateurs de Pétrole*. A large tank-barge is alongside the Port Rambaud quays. In addition to this oil-port, there are several other depots in Lyons, including the new oil-dock at Port Edouard Herrict. Nearly four million tons of mineral oil are transported annually on French inland waterways.



Plate 95. An oil tank-barge

The barge is alongside wharves on the Loire Lateral Canal at Argenvières; it is interesting to note that this is almost exactly the geometrical centre of France. Note the pipe used for rapid transhipment.





Plates 96, 97. Rove Tunnel

Plate 96 (above) shows the north end of the tunnel, which continues through the Tranchée de Gibnac (cutting) into the Etang de Bolmon. Plate 97 (below) shows the southern exit into the Mediterranean Sea near Port de la Lave.



This canal forms the more important half, as yet, of the through-waterway from Arles to Marseilles. From Port-de-Bouc (Figs. 53, 54), at the end of the Arles-Bouc Canal, shipping passes through the Etang de Caronte, a drowned valley which forms a 6 km. long strait from the Etang de Berre to the Golfe de Fos. It is crossed by the 40 m. turning span of the Caronte viaduct of the railway from Miramas to Estaque. It has been excavated to form a channel 10 m. deep for shipping. From Martigues navigation proceeds along the southern shores of the Etangs de Berre and de Bolmon, in a channel 50 m. wide dredged to 9 m. as far as the Caronte viaduct, but beyond, to the east, the channel diminishes to 30 m. wide and 8 m. deep. The southern shores of the lagoon, which were rocky and broken up by pools, have been levelled and extended outwards by concrete quays flanked by deep water. The shallow northernmost end of the lagoon is being filled up and converted into a quay space of great area, intersected by deep-water basins, with extensive sidings and railway depots. When completed it is estimated that it will have  $1\frac{1}{2}$  times the length of the quays at Marseilles and 5 or 6 times the storage facilities. Along this section extensive wharves and railway sidings linked with Marseilles have been built, and new heavy industries and oil refineries are developing there.

The canal is then led by way of the Rove tunnel through the Chaîne de la Nerthe. This tunnel has a watercourse 4 m. deep and is wide enough (22 m.) for a double stream of traffic. The roof of the tunnel is 9.90 m. above the towpath, which itself is 1.50 m. above the water level. A channel protected by a dike leads from the southern end of the tunnel into Marseilles docks (Figs. 46, 51, Plates 96, 97).

The canal shortens the distance from Martigues to Marseilles by some 19 km. (see p. 191), and in addition allows shipping to avoid the crossing of the Golfe de Fos, which can be very stormy when the mistral is blowing.

The chief cargo is coal and lignite, both used as fuel for the industries of Marseilles, while a variety of manufactured goods are carried towards the Rhône.

Ports	Km.	Wharves, factories, etc.
Port-de-Bouc	0	{ Quays, railway sidings, depots. Heavy industries. Oil refineries
Martigues	5	
Marignane	17	
Tranchée de Gibnac	18	
Rove tunnel	20	See p. 191
Rove tunnel	27	
Marseilles	30	



58. *St Louis Canal*

(a) Freycinet classification	Main
(b) Length	3.3 km. + 1750 m. extension into Golfe de Fos
(c) Depth	7.50 m.
(d) Locks	1 (F)
(e) Fixed bridges	1 (F)
(f) Tunnels	None
(g) Traction	Tug. Metalled towpath on north, unmetalled on south
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

This short canal (Fig. 44) provides a channel 7.5 m. deep and 63 m. wide from Port-St Louis-du-Rhône (Fig. 45) through the Etang de Gloria to the Golfe du Fos, avoiding the sand and mud banks where the Grand Rhône enters the Mediterranean. About 100,000 metric tons, chiefly of phosphates, lime, cement, oil and wine, are imported or exported annually through the canal. Four-fifths of the total trade of St Louis is transhipped there to P.L.M. Railway lines owing to the unsuitability of the Grand Rhône for navigation (Fig. 52).

59. *Rhône-Sète Canal*

(a) Freycinet classification	Main
(b) Length	98 km.
(c) Depth	2.00 m.
(d) Locks	3 (F)
(e) Fixed bridges	22 (F)
(f) Tunnels	None
(g) Traction	Tug, rarely by horse. Metalled towpath
(h) Tonnage (1936)	255,000
(i) Barge journeys (1936)	2,006

The Rhône-Sète Canal, completed in 1934, runs from the Etang de Thau near La Peyrade to Beaucaire on the Rhône. It follows a diked channel through the lagoons to the old town of Aigues-Mortes (Plate 98), and then skirts the western edge of the main delta. Barges up to 600 metric tons can use the canal.

The harbours of Sète (Figs. 42, 43) are joined first to the main canal by the Lateral Canal and by the Peyrade Canal, which runs to La Peyrade at the eastern end of the Etang de Thau, and second to the Etang de Thau by the Sète Canal. Access to the Mediterranean from Sète is by the Maritime Canal, which has been dredged to about 7 m. The convergence of the two canals, Midi and Rhône-Sète, on the port of Sète has helped to make it the eighth port of France in respect of tonnage handled (Plate 99). Each canal carries about 125,000 metric tons per annum to or from the port.





Plate 98. Rhône-Sète Canal at Aigues-Mortes

The canal runs north-east to Beaucaire on the Rhône. In the foreground is a junction basin, situated to the north-west of the town. The Bourgidou Canal comes in on the right, while another section of the Rhône-Sète Canal comes in on the left.



Plate 99. Sète

The Sète Canal, which runs roughly north and south through the town, connects the maritime port with the Etang de Thau and with the Rhône-Sète Canal.





Plate 100. An aqueduct near Béziers

Near Béziers the Midi Canal is carried over the River Orb. A series of locks enable vessels to descend from the canal to the river.



Plate 101. Lock and basin at Carcassonne

The view shows one of sixty-five locks by which the Midi Canal crosses the water-parting between the Atlantic and Mediterranean.



Ports	Km.	Wharves, factories, etc.
Beaucaire (0·11 M.m.t.) (R. Rhône)	0	Wharves
St Montant	2	Dock basin
Bellegarde	13	Wharves and railway sidings
Aigues-Mortes (Bourgidou C.)	50	Public and private wharves. Railway sidings
Canalet (Lunel C.)	60	
Croisée-du-Lez (Lez Canal)	75	
La Peyrade (Sète C.)	96	Wharves
Etang de Thau	98	

### *Branches of the Rhône-Sète Canal*

These short branches link the main canal at various points with the Petit Rhône, with the Mediterranean and with a few small towns.

	(i) Canal Peyrade	(ii) Lez Canal	(iii) Lunel Canal
(a) Freycinet classification	Secondary	Secondary	Secondary
(b) Length	2 km.	2 km.	9 km.
(c) Depth	1·80 m.	1·50 m.	1·50 m.
(d) Locks	None	None	None
(e) Fixed bridges	3 (F)	1 (3·10 m.)	None
(f) Tunnels	None	None	None
(g) Traction	Tug. Metalled towpath	Horse. Metalled towpath	Horse and man-power. Metalled towpath
(h) Tonnage (1936)	Included in return of main canal	Included in return of main canal	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal	Included in return of main canal	Included in return of main canal
	(iv) Branch of Lunel Canal	(v) Canal Sylvéréal	(vi) Bourgidou Canal
(a) Freycinet classification	Secondary	Secondary	Secondary
(b) Length	2 km.	9 km.	11 km.
(c) Depth	1·50 m.	1·50 m.	1·50 m.
(d) Locks	None	1 (F but depth 1·50 m.)	1 (F but depth 1·50 m.)
(e) Fixed bridges	1 (3·35 m.)	1 (F)	None
(f) Tunnels	None	None	None
(g) Traction	Horse and tug. Metalled towpath	Horse and tug. Metalled towpath	Horse and tug. Metalled towpath
(h) Tonnage (1936)	Included in return of main canal	Included in return of main canal	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal	Included in return of main canal	Included in return of main canal

### 60. *Midi Canal*

(a) Freycinet classification	Secondary
(b) Length	240 km.
(c) Depth	1·80 m.
(d) Locks	65 (F but depth 1·80 m.)
(e) Fixed bridges	124 (2 m.)



(f) Tunnels	One. 164 × 6 m. clearance
(g) Traction	Unmetalled towpath for most of length
(h) Tonnage (1936)	Including Garonne Lateral C. 502,000
(i) Barge journeys (1936)	Including Garonne Lateral C. 6,632

The Midi Canal, which was opened in 1681, joins the Garonne at Toulouse with the Mediterranean coastal navigation at the Etang de Thau, and sends off the Nouvelle branch to Narbonne and to the sea at La Nouvelle (see p. 211). There are also two short branches which descend by locks to the rivers Orb and Hérault. It makes use of the gap between the Montagne Noire and the Corbières mountains—the Gate of Carcassonne—crossing the water-parting between the Atlantic and Mediterranean slopes.

In the latter half of the nineteenth century the concessions of the canal and of the Garonne Lateral were obtained by the Midi Railway Co., and the development of the two canals was strangled by tariffs designed to divert traffic to the railway. The canal during this period of decadence fell into disrepair. The freedom of navigation and tariff reduction which followed after the State had bought back the canal concession in 1898 could not restore the prosperity which the railway had taken. In 1921 the government revived Freycinet's proposals for improvement and spent large sums of money on making the canal navigable for barges up to 300 tons, although the great majority of vessels at the present time are only of 120-ton capacity. The bed was dredged and metal lockgates installed. Replacement of horse haulage by motor power began in 1928, and by 1939 was complete except for four vessels, with resultant speeding up of traffic (Plates 100, 101).

The chief cargoes are wine and other agricultural produce, cement, petroleum and other hydrocarbons, casks and coal. Wine moves in both directions from Bordeaux and Languedoc and is also imported at Sète from Algeria.

There have been many schemes for the replacement of the inadequate Midi and Garonne Lateral Canals by a much larger 'Canal des Deux Mers'. The project was first advanced in the early nineteenth century, but it was not until 1928 that a committee was formed, which after a congress at Toulouse in 1932 produced plans. It was to be 315 km. long (from Bordeaux to La Nouvelle) and 150 m. wide, and would allow ocean-going vessels to pass from the Atlantic to the Mediterranean. Owing to its immense cost, the project met with no support from the French government until February, 1939, when it was stated that preliminary government consent had been obtained; no further action has been taken.

*Branches of the Midi Canal*

	(i) Nouvelle branch Béziers to La Nouvelle	(ii) Orb branch	(iii) Hérault branch
(a) Freycinet classification	Secondary	Secondary	Secondary
(b) Length	37 km.	2 km.	1 km.
(c) Depth	1·80 m.	1·80 m.	1·80 m.
(d) Locks	13 (F but depth 1·30 m.)	2 (F but depth 1·80 m.)	1 (dimensions not stated)
(e) Fixed bridges	21 (2·60 m.)	3 (2·60 m.)	2 (2·60 m.)
(f) Tunnels	None	None	None
(g) Traction	Unmetalled towpath	Unmetalled towpath	Metalled towpath
(h) Tonnage (1936)	Included in return of main canal	Included in return of main canal	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal	Included in return of main canal	Included in return of main canal

*61. River Hérault*

(a) Freycinet classification	Secondary
(b) Length	12 km.
(c) Depth	Section above Agde: 2·20 m. (min.); 3·50 m. (mean). Section below Agde: 3·00 m. (min.); 4·00 m. (mean)
(d) Locks	1 (F) at junction of Midi Canal
(e) Fixed bridges	2 (F)
(f) Tunnels	None
(g) Traction	Metalled towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

There is virtually no traffic above Agde, although the Hérault is classed as navigable. Most traffic is on the short stretch through the town.

*62. River Lez*

(a) Freycinet classification	Secondary
(b) Length	10 km.
(c) Depth	1·50 m. (min.); 2·00 m. (mean)
(d) Locks	3 (F)
(e) Fixed bridges	5 (3·10 m.)
(f) Tunnels	None
(g) Traction	Out of use. Unpaved towpath
(h) Tonnage (1936)	None
(i) Barge journeys (1936)	None

The river, although classed as navigable, is not used. The locks are not maintained in repair, and while the theoretical depth is 2 m. the sluices and much of the bed are choked with mud.



## LOIRE BASIN

The waterways of the Loire Basin are shown on Fig. 119 (upper section of basin), on Fig. 118 (middle section of basin), and on Figs. 121 and 122 (lower section of basin).

63. *River Loire*

	Section (i) St Nazaire to Nantes	Section (ii) Nantes to Vienne confluence	Section (iii) Vienne confluence to Lestiou
(a) Freycinet classification	Main	Secondary	Secondary
(b) Length	56 km. (effectively)	146 km.	137 km.
(c) Depth	3.40 m. (min.); 7.30 m. (mean)	0.50 m. (min.); Mean variable	0.25 m. (min.); 0.70 m. (mean)
(d) Locks	None	None	None
(e) Fixed bridges	12 (F)	None	4 (4.15 m.)
(f) Tunnels	None	None	None
(g) Traction	Tugs. Metalled towpath	Tugs. Towpath metalled in places	None
(h) Tonnage (1936)	90,000	64,000	None
(i) Barge journeys (1936)	1,548	804	None

	Section (iv) Lestiou to Briare	Section (v) Briare to Roanne	Section (vi) Roanne to Vorey
(a) Freycinet classification	Secondary	Secondary	Secondary
(b) Length	114 km.	270 km.	102 km.
(c) Depth	0.25 m. (min.); 0.70 m. (mean)	0.25 m. (min.); 0.50 m. (mean)	Variable (below 1 m.)
(d) Locks	None	None	None
(e) Fixed bridges	11 (4.15 m.)	27 (F)	None
(f) Tunnels	None	None	None
(g) Traction	None	Tugs. Towpath metalled in places	None
(h) Tonnage (1936)	None	308,000	None
(i) Barge journeys (1936)	None	11,602	None

If judged by the size of its river basin, the Loire ought to be one of the most valuable waterways in France. A total length of 825 km. is classified officially as navigable, although there was no navigation on 353 km. of its length in 1936. But its headwaters rise on the impervious crystalline rocks of the Central Massif, which cause a rapid run-off in times of heavy rain or melting snow (November to April), sending down sweeping floods to the plains, charged with vast quantities of coarse sand which are deposited in the bed in great banks. They dry up as quickly during the summer and the

Loire is reduced almost to a ditch, hardly noticeable among the vast sandy stretches of its flood-bed.

The need for an east to west highway across central France which should link up with the north-south communications between Paris and the industrial regions of central France has often been stressed, and since 1919 the State has promoted experiments to control the river. Attempts have been made by a system of groins to stabilize the shifting bed of the river and to provide a deeper channel at mean and low water. Although the results have not been commensurate with the effort, there has been an appreciable increase in the amount of traffic above Nantes.

A group of short canals in the upper Loire basin links the Loire with the Seine and the Saône-Rhône; these serve the small industrial metallurgical district of Nevers and Montluçon (Le Nivernais) and the more important coalfields and metallurgical centre of Le Creusot-Blanzay. Traffic is virtually restricted to the estuary below Nantes, to the section from the Vienne confluence near Montsoreau to Nantes, and to an upper section between Roanne and Briare. Although the upper section is paralleled by canals, it carried about 300,000 metric tons of traffic in 1936, the greater part of which consisted of downstream cargoes of sand, gravel and bricks.

Section (i). St Nazaire to Nantes

Ports	Km.	Wharves, factories, etc.
St Nazaire	0	Docks (see pp. 105-13)
Méan (R. Brivet confluence)	3	
Paimbœuf	15	Wharves. Etat railway sidings
Carnet (Canal Maritime)	23	
La Martinière (Canal Maritime)	38	
Haute-Indre	48	Beginning of maritime port of Nantes
Nantes (0.33 M.m.t.)	56	Docks (see pp. 113-22)

64. *Basse-Loire Canal*

(a) Freycinet classification	Secondary
(b) Length	15 km.
(c) Depth	3.00 m.
(d) Locks	2 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	None
(h) Tonnage (1936)	None
(i) Barge journeys (1936)	None

This canal, which runs parallel to the south bank of the Loire



estuary, was opened in 1892, but since the estuary has been effectively deepened the canal is no longer used.

### 65. *River Mayenne-Maine*

(a) Freycinet classification	Secondary
(b) Length	135 km.
(c) Depth	Upper section 1.50 m. Lower section 1.60 m.
(d) Locks	45 (F except depth 1.50 m.)
(e) Fixed bridges	24 (2.48 m.)
(f) Tunnels	None
(g) Traction	Horse. Metalled towpath
(h) Tonnage (1936)	218,000
(i) Barge journeys (1936)	2,166

Traffic on the Maine leaves the Loire at La Pointe and passes 8 km. upstream to Angers, above which several rivers converge. The most important of these is the Mayenne, navigable for small craft to Brives.

There has been in recent years an improvement in the traffic of these waterways, due partly to regularization of the channel to Angers, and partly to the employment of shallow-draught motor boats. The only important cargo, however, is that from the slate quarries near Angers.

### 66. *Dive Canal*

(a) Freycinet classification	Secondary
(b) Length	40 km.
(c) Depth	1.60 m.
(d) Locks	11 (F but depth 1.60 m.)
(e) Fixed bridges	20 (2.60 m.)
(f) Tunnels	None
(g) Traction	Man-power and sail. Unmetalled towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

This canal, 12 km. of which follow the bed of the river Thouet, is used only to a very slight extent by small barges carrying sand, gravel and bricks.

### 67. *Orléans Canal*

(a) Freycinet classification	Secondary
(b) Length	79 km.
(c) Depth	1.25 m.
(d) Locks	27 (30.18 × 5.20 × 1.30 m.)
(e) Fixed bridges	44 (3.35 m.)
(f) Tunnels	None
(g) Traction	Horse, mule and donkey. Unmetalled towpath
(h) Tonnage (1936)	34,000
(i) Barge journeys (1936)	439

This canal forms a secondary link between the Loire at Orléans and the Seine via the Loing Canal. It is used only by small animal-hauled barges.

#### 68. *Sauldre Canal.*

(a) Freycinet classification	Secondary
(b) Length	35 km.
(c) Depth	1.50 m.
(d) Locks	22 ( $22.75 \times 2.70 \times 1.50$ m.)
(e) Fixed bridges	48 (3.00 m.)
(f) Tunnels	None
(g) Traction	Horse. Unpaved towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

This little-used waterway links up small towns and villages near the Seine tributaries of the Sauldre and Beuvron.

#### 69. *Berry Canal*

This canal starts from the industrial centre of Montluçon, follows the upper Cher to St Amand, and turns off to Fontblisse (Branch (i)). From Fontblisse it sends out two branches, one to Noyers on the Cher (Branch (ii)), and another to join the Loire Lateral Canal at Marseilles-les-Aubigny (Branch (iii)).

	(i) Montluçon to Fontblisse	(ii) Noyers to Fontblisse	(iii) Fontblisse to Marseilles- les-Aubigny
(a) Freycinet classification	Secondary	Secondary	Secondary
(b) Length	70 km.	142 km.	49 km.
(c) Depth	1.50 m.	1.50 m.	1.50 m.
(d) Locks	53 ( $27.75 \times 2.70$ $\times 1.50$ m.)	26 ( $27.75 \times 2.70$ $\times 1.50$ m.)	17 ( $27.75 \times 2.70$ $\times 1.50$ m.)
(e) Fixed bridges	42 (3.00 m.)	69 (3.00 m.)	28 (3.00 m.)
(f) Tunnels	None	None	None
(g) Traction	Ass and mule, rarely horse. Gravelled tow- path	Ass and mule, rarely horse. Gravelled tow- path	Ass and mule, rarely horse. Gravelled tow- path
(h) Tonnage (1936)	157,000	166,000	271,000
(i) Barge journeys (1936)	2,699	2,973	4,786

The navigable depth of the canal is only about 1.5 m.; as a result it can take barges with a capacity of only about 60–70 tons. The canal supplies the small industrial centres with iron ore, coal and limestone, while pit-props form a large part of return cargoes. The total traffic is about 300,000–400,000 metric tons and is diminishing.



70. *Briare Canal*

(a) Freycinet classification	Main
(b) Length	57 km.
(c) Depth	2.00 m.
(d) Locks	36 (F but 1.60 m. depth)
(e) Fixed bridges	40 (3.56 m.)
(f) Tunnels	None
(g) Traction	Horse and tractor. Metalled or gravelled towpath
(h) Tonnage (1936)	Including Loing C. 1,524,000
(i) Barge journeys (1936)	Including Loing C. 9,675

The canal joins the Loire and the Loire Lateral Canal to the Loing Canal at Buges near Montargis. It has a double contact with the Loire —by the old branch at Briare and by a new branch, 3 km. upstream, at La Cognardière. It therefore forms an important link between the Seine and Loire systems. Besides cargoes of limestone, coal, gravel and sand, it taps the products of the great Forêt de Orléans, and sends large quantities of pit-props to the north-east coalfield.

Ports	Km.	Wharves, factories, etc.
Briare (Loire Lateral Canal)	0	
Montargis (0.14 M.m.t.)	52	Wharves serving tanneries, rubber and chemical factories. Turning basin. Railway sidings
Buges (Orléans C., Loing C.)	57	Wharves and turning basin

71. *Loire Lateral Canal*

(a) Freycinet classification	Main
(b) Length	196 km.
(c) Depth	2.00 m.
(d) Locks	37 (F)
(e) Fixed bridges	141 (F)
(f) Tunnels	None
(g) Traction	Horse, mule and tractor. Gravelled towpath, but metalled in short sections
(h) Tonnage (1936)	1,893,000
(i) Barge journeys (1936)	16,451

The canal runs parallel to the Loire from Briare to Digoin, and it continues the line of the Briare Canal in the north and the Roanne-Digoin Canal in the south (Plate 95).

Ports	Km.	Wharves, factories, etc.
La Cognardière (Briare C.)	0	
L'Etang (Châtillon branch)	13	
St Satur (St Thibault branch)	40	Wharves. Railway sidings (P.O.). Various factories
Beffes (0.22 M.m.t.)	72	

Marseilles-les-Aubigny (Berry C.)	75	Wharves
Crille (Fourchambault branch)	82	
Le Guétin (feeder from R. Allier)	88	Wharves
Gimouille	89	Wharves. Railway sidings (P.L.M. and P.O.)
Verville (Nevers branch)	99	
Chevenon	106	Private wharves serving iron and steel works
St Maurice (Decize branch, junction with R. Loire and Nivernais C.)	131	
Bébre-Sept-Fonds (Dompierre branch)	170	Wharves
Fontaine-St Martin	191	Wharves. Railway sidings
Chassenard (Roanne- Digoïn C.)	194	Wharves. Dock basin
Le Cimetière (Centre C.)	196	Wharves

### *Branches of the Loire Lateral Canal*

Numerous short branches lead from the main canal to adjacent towns.

	(i) Dompierre. Dompierre to Bébre	(ii) Decize. St Maurice to Decize	(iii) Nevers. Verville to Nevers
(a) Freycinet classification	Main	Main	Main
(b) Length	3 km.	1 km.	3 km.
(c) Depth	2.00 m.	2.00 m.	2.00 m.
(d) Locks	None	2 (F)	3 (F but 30.00 m. long)
(e) Fixed bridges	5 (F)	2 (F)	3 (F)
(f) Tunnels	None	None	None
(g) Traction	Horse, mule and tractor. Gravelled towpath	As branch (i)	As branch (i)
(h) Tonnage (1936)	Included in return of main canal	As branch (i)	As branch (i)
(i) Barge journeys (1936)	Included in return of main canal	As branch (i)	As branch (i)
	(iv) Lorraine. Near La Greceville to R. Allier	(v) Fourchambault. Crille to Fourchambault	(vi) St Thibault. St Satur to St Thibault
(a) Freycinet classification	Secondary	Main	Main
(b) Length	3 km.	2 km.	1 km.
(c) Depth	1.60 m.	2.00 m.	2.00 m.
(d) Locks	1 (circular, diam. 32 m.)	2 (F)	1 (30 m. long F)
(e) Fixed bridges	6 (3.40 m.)	3 (3.20 m.)	2 (F)
(f) Tunnels	None	None	None
(g) Traction	As branch (i)	As branch (i)	As branch (i)
(h) Tonnage (1936)	As branch (i)	As branch (i)	As branch (i)
(i) Barge journeys (1936)	As branch (i)	As branch (i)	As branch (i)



	(vii) Châtillon-sur-Loire. L'Etang to Châtillon	(viii) Combles and Baraban. Les Combles to Briare
(a) Freycinet classification	Secondary	Secondary
(b) Length	5 km.	5 km.
(c) Depth	1.60 m.	1.60 m.
(d) Locks	3 (30 × 5.20 × 1.00 m.)	1 (30 × 5.20 × 1.60 m.)
(e) Fixed bridges	6 (2.87 m.)	11 (3.39 m.)
(f) Tunnels	None	None
(g) Traction	As branch (i)	As branch (i)
(h) Tonnage (1936)	As branch (i)	As branch (i)
(i) Barge journeys (1936)	As branch (i)	As branch (i)

## 72. Roanne-Digoin Canal

(a) Freycinet classification	Main
(b) Length	56 km.
(c) Depth	2.00 m.
(d) Locks	10 (F)
(e) Fixed bridges	56 (F)
(f) Tunnels	None
(g) Traction	Horse, mule and tractor. Metalled or gravelled towpath
(h) Tonnage (1936)	549,000
(i) Barge journeys (1936)	8,681

This canal is a southern continuation of the Loire Lateral Canal.

The textile centre of Roanne collects from the neighbouring industrial valleys and supplies them with coal, iron ore, sugar and other foodstuffs. Traffic, however, is on a relatively small scale.

Ports	Km.	Wharves, factories, etc.
Digoin (Loire Lateral C.)	0	Wharves
Aiguilly	51	Private wharves. Railway sidings
Oudan	54	Large dock basin. Railway sidings (P.L.M.)
Roanne (0.50 M.m.t.) (R. Loire)	56	Wharves. Railway sidings (P.L.M.)

## 73. Nivernais Canal

(a) Freycinet classification	Secondary
(b) Length	174 km.
(c) Depth	1.50 m.
(d) Locks	114 (30.15 × 5.10 × 1.50 m.)
(e) Fixed bridges	116 (2.53 m.)
(f) Tunnels	Three: (i) 758 m., (ii) 268 m., (iii) 212 × 3.73 × 5.60 m.
(g) Traction	Tractor, horse and mule. Towing through tunnel. Gravelled towpath
(h) Tonnage (1936)	208,000
(i) Barge journeys (1936)	1,932

This waterway forms a transverse link between the Loire and the Yonne. The water-parting is traversed by means of a large number of locks and three tunnels. It is mainly concerned in the transport of pit-props from the Morvan to the Nord coalfield. Numerous small ports such as Clamecy and Armes are the organizing centres for the

export of timber, and timber wharves continue down the canal to Auxerre. The traffic has fallen off greatly of late years, mainly owing to road competition.

### *Vermonton Branch of the Nivernais Canal*

(a) Freycinet classification	Secondary
(b) Length	4 km.
(c) Depth	1.60 m.
(d) Locks	2 (F but 1.50 m. deep)
(e) Fixed bridges	5 (3.35 m.)
(f) Tunnels	None
(g) Traction	Tractor, horse and mule. Gravelled towpath
(h) Tonnage (1936)	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal

### 74. *Centre Canal*

(a) Freycinet classification	Main
(b) Length	114 km.
(c) Depth	2.00 m.
(d) Locks	63 (F)
(e) Fixed bridges	78 (F)
(f) Tunnels	None
(g) Traction	Horse and donkey. Towpath is roadway for 91 km. Rest is gravelled
(h) Tonnage (1936)	1,662,000
(i) Barge journeys (1936)	9,825

The canal links the Loire and Saône waterways and joins the Nivernais metallurgical district with the Saône via the Blanzly-Le Creusot coalfield. The wharves of the collieries of the Blanzly coalfield lie along the canal. The colliery port of Montceau-les-Mines was one of the ten inland ports in 1936 to handle over a million metric tons of water-borne freight; almost the whole of it consisted of coal shipped from the port.

Ports	Km.	Wharves, factories, etc.
Digoin (Loire Lateral C.)	2	Public and private wharves. Railway sidings. Wharves owned by pottery factories
La Bourbince (near Arroux branch)	6	
Paray-le-Monrial	16	Private wharves serving pottery factory
Valteuse	40	Coal wharves serving Blanzly coalfield
Montceau-les-Mines (1.03 M.m.t.)	53	Dock capacity for 55 barges. Private wharves connected with Blanzly mines. Coal-storage depot
Bois-Bretoux	66	Public and private wharves serving metallurgical industries. Rail connexion with Le Creusot. Etang du Creusot reservoir to feed canal
Perreuil	76	Public and private wharves serving iron and steel works
Chalon-sur-Saône (0.35 M.m.t.) (R. Saône)	116	Wharves. Railway sidings



*Branches of the Centre Canal*

Two short branches link the canal with the Loire Lateral Canal and with the small industrial town of Geugnon.

	(i) Junction with Loire Lateral C.	(ii) Arroux branch (La Bourbince to Geugnon)
(a) Freycinet classification	Main	Secondary
(b) Length	2 km.	14 km.
(c) Depth	2.00 m.	1.50 m.
(d) Locks	3 double (30.30 m. long)	2 (30.70 × 2.70 × 1.50 m.)
(e) Fixed bridges	4 (2.67 m.)	5 (3.30 m.)
(f) Tunnels	None	None
(g) Traction	As main canal	As main canal
(h) Tonnage (1936)	Included in return of main canal	Included in return of main canal
(i) Barge journeys (1936)	Included in return of main canal	Included in return of main canal

*75. River Cher*

(a) Freycinet classification	Secondary
(b) Length	153 km. (of which middle 62 km. is canalized)
(c) Depth	0.75 m. (min.); 1.20 m. (mean)
(d) Locks	16 (35 m. long)
(e) Fixed bridges	16 (3.60 m.)
(f) Tunnels	None
(g) Traction	(i) Upper 70 km. No haulage. Unpaved towpath (ii) Middle section. Sails and donkey. Paved, metalled or unpaved (iii) Lower section. No haulage. Unpaved towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

The Cher is classified as navigable for 153 km. In actual fact only the middle section of 62 km., which has been canalized, is utilized to any extent. The upper section, above Noyers, is used only for downstream traffic. There is no system of haulage and boats drift down with the current. Three points on this section are described as 'perilous'. The middle section is used to a greater extent, but even so traffic is relatively light and mostly downstream. At Tours traffic transfers through a short canal to the Loire; as a result the lower section of 21 km. to the Loire-Cher confluence is not utilized for navigation.

*Junction Canal with Loire*

(a) Freycinet classification	Secondary
(b) Length	2 km.
(c) Depth	Variable (under 2 m.)
(d) Locks	2 (35 m. long)
(e) Fixed bridges	1 (3.30 m.)
(f) Tunnels	None
(g) Traction	As main river
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

This short canal links the Cher at Rochepinard with the Loire at Tours.

## NORTH-WESTERN AND WESTERN FRANCE

These canals are, with two exceptions, short and serve to link estuary towns with the open sea, thus avoiding the navigational difficulties of the estuary. In addition, certain of the larger rivers have short sections of their lower courses navigable. The only waterways of any length are the Nantes-Brest Canal in the north-west and the Garonne Lateral Canal in Aquitaine (Figs. 121, 122). There are very few industries of any magnitude in this part of France, and as a result the great bulk cargoes of ore, coke, etc., which form such a large part of the traffic of eastern France, are absent. The chief commodities conveyed include coal for domestic purposes, building materials such as bricks, lime and sand, timber, wine, and agricultural produce such as flour.

76. *Caen à la Mer Canal*

(a) Freycinet classification	Main
(b) Length	15 km.
(c) Depth	5.64 m.
(d) Locks	2 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	Sanded towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

A lateral canal (which uses the river bed for short distances) was begun in 1812 to reopen communication between Caen and the sea. Subsequent improvements, including the development of Ouistreham as an outport and a barrage across the Orne to form basins for canal traffic at Caen, together with successive deepening to give a minimum depth of 6.56 m., have made the port adequate for cargo boats up to 5,500 metric tons (see pp. 66–81). The upper end of the canal is lined with quays and sidings (Figs. 16, 17, and Plate 14).

Ports	Km.	Wharves, factories, etc.
Ouistreham	0	Avant-port
Caen	15	Industrial and market centre (see pp. 66–72)

77. *Vire-et-Taute Canal*

(a) Freycinet classification	Secondary
(b) Length	12 km.
(c) Depth	1.10 m.
(d) Locks	3 (20.40 × 4.20 × 1.10 m.)
(e) Fixed bridges	6 (2.10 m.)
(f) Tunnels	None
(g) Traction	Horse. Metalled towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated



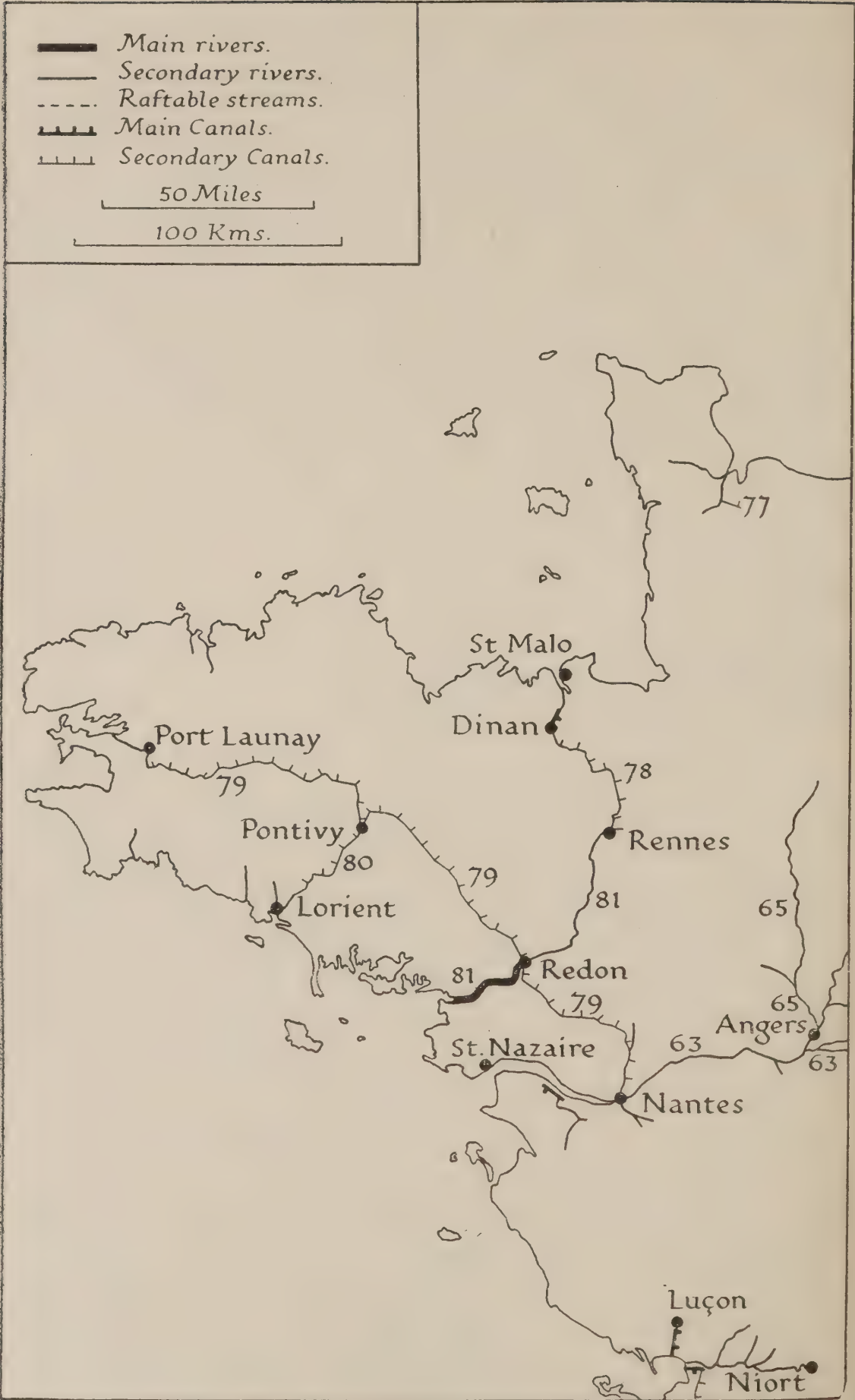


Fig. 121. Waterways of north-western France

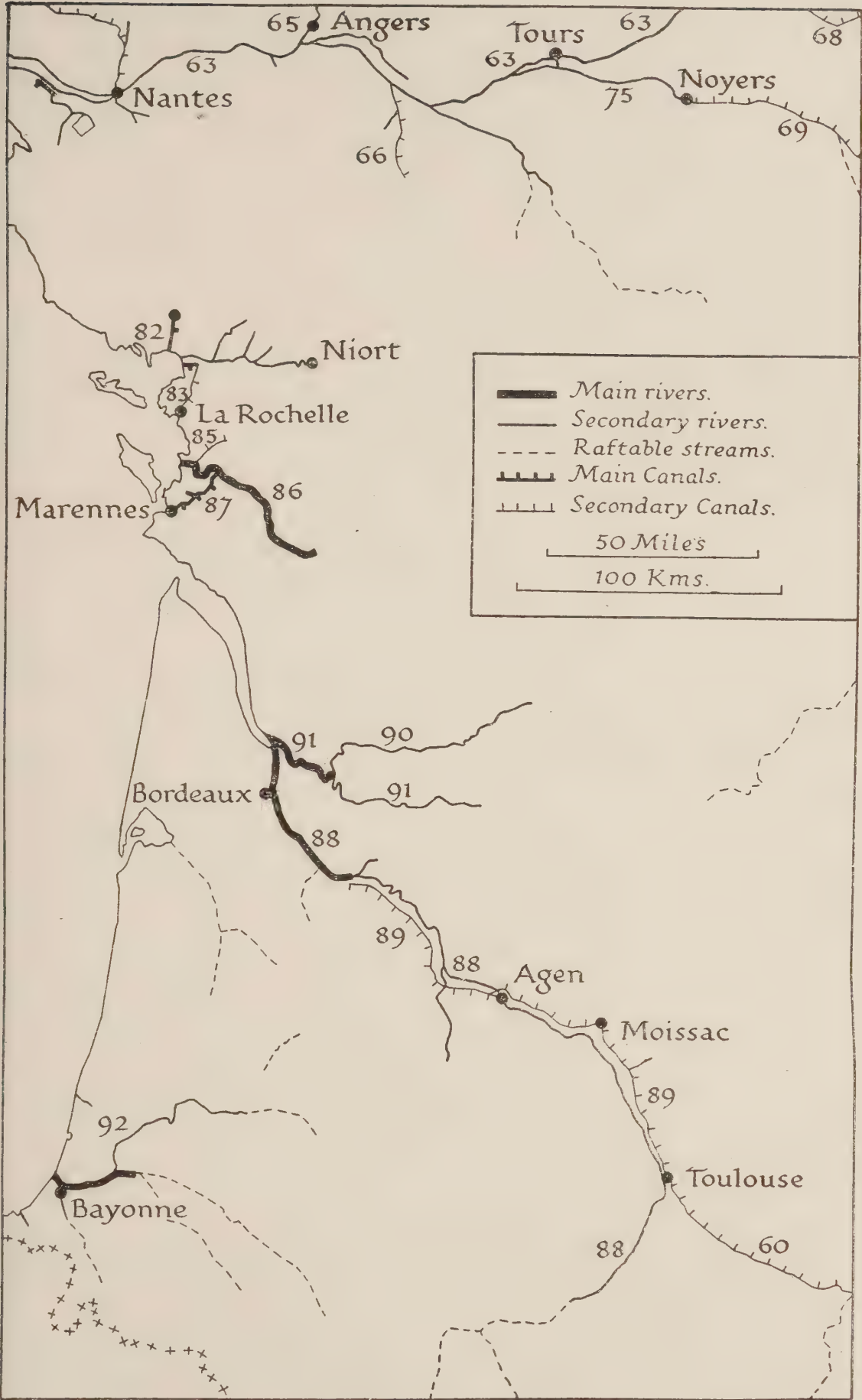


Fig. 122. Waterways of south-western France



This canal joins the rivers Vire and Taute, and is supplied with water from the Vire by a barrage at Porribet. There are floods in winter, when the towpath is often covered with water and navigation ceases. The canal is used only to a small extent by horse-hauled lighters with a capacity of 18 metric tons.

### 78. *Ille-et-Rance Canal*

(a) Freycinet classification	Secondary
(b) Length	85 km.
(c) Depth	1.60 m.
(d) Locks	48 (27.00 × 4.65 × 1.60 m.)
(e) Fixed bridges	43 (2.35 m.)
(f) Tunnels	None
(g) Traction	Horse. Metalled towpath
(h) Tonnage (1936)	54,000
(i) Barge journeys (1936)	817

The canal connects the Vilaine at Rennes with the Rance at Dinan, and thus forms a waterway across the Armorican Peninsula.

### 79. *Nantes-Brest Canal*

The long Nantes-Brest Canal may be conveniently divided into two sections.

	Section (i) Nantes-Redon	Section (ii) Redon to Châteaulin (Port-Launay)
(a) Freycinet classification	Secondary	Secondary
(b) Length	95 km.	265 km.
(c) Depth	1.62 m.	1.62 m.
(d) Locks	17 (26.50 × 4.70 × 1.40 m.) 1 (32.14 × 5.16 × 1.40 m.)	201 (25.70 × 4.65 × 1.30 m.)
(e) Fixed bridges	40 (F)	95 (2.35 m.)
(f) Tunnels	None	None
(g) Traction	Horse. Gravelled towpath	Horse and tractor. Gravelled towpath
(h) Tonnage (1936)	280,000	82,000
(i) Barge journeys (1936)	3,053	1,037

The canal must be regarded as a *pis-aller*, supplementing the railways which are handicapped in their east-to-west development by the deep inlets which keep road and rail away from the coast and are usually avoided by the roads. It carried in 1936 about a quarter of a million metric tons, consisting chiefly of coke and coal and some agricultural machinery to the interior.

80. *Blavet Canal*

(a) Freycinet classification	Secondary
(b) Length	60 km.
(c) Depth	1.62 m.
(d) Locks	28 (26.30 × 4.70 × 1.62 m.)
(e) Fixed bridges	21 (2 m.)
(f) Tunnels	None
(g) Traction	Tractor and horse. Gravelled towpath
(h) Tonnage (1936)	130,000
(i) Barge journeys (1936)	1,242

This links Pontivy on the Nantes-Brest Canal with Hennebont on the Blavet estuary, near the mouth of which is Lorient (see pp. 98–105). The chief cargoes are pit-props from the Armorican uplands; these provide a return freight for the Welsh coal which comes to Lorient and to the steel works of Hennebont.

81. *River Vilaine*

(a) Freycinet classification	Secondary
(b) Length	145 km.
(c) Depth	Section (i) sea to Redon, 3.00 m. (low tide); 4.50 m. (high tide). Section (ii) Redon to Malon, 1.00 m. (min.); 1.50 m. (mean). Section (iii) Malon to Cesson, 1.15 m.
(d) Locks	15 (26.65 × 4.70 × 1.00 m.)
(e) Fixed bridges	32 (2.30 m.)
(f) Tunnels	None
(g) Traction	Horse. Metalled towpath, except for 54 km. of upper section, which is natural
(h) Tonnage (1936)	163,000
(i) Barge journeys (1936)	2,709

The Vilaine is navigable from Rennes to the estuary. Below Redon it ranks as a main waterway and links the Nantes-Brest Canal to the sea.

82. *Luçon Canal*

(a) Freycinet classification	Main
(b) Length	14 + 4 km. into sea
(c) Depth	2.30 m.
(d) Locks	1 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	None
(h) Tonnage (1936)	None
(i) Barge journeys (1936)	None

Navigation on this canal was discontinued in 1933.

83. *Marans Canal*

(a) Freycinet classification	Secondary
(b) Length	24 km.
(c) Depth	1.60 m.
(d) Locks	4 (23.50 × 5.20 × 1.60 m.)



(e) Fixed bridges	10 (7 river, (F)) (3 maritime, (2.75 m.))
(f) Tunnels	1 (842 × 6.20 m. clearance)
(g) Traction	Horse and man-power. Metalled in marshy sections
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

For a distance of about 12 km. this canal traverses drained marshes; for the rest of the distance it is cut through limestone, and for 842 m. it is led through the Tunnel of St Leonard (Fig. 30). The canal is now little used.

#### 84. *River Sèvres(-Niortaise)*

(a) Freycinet classification	Secondary
(b) Length	74 km.
(c) Depth	1.50 m. (min.); 2.00 m. (mean)
(d) Locks	7 (31.50 × 5.20 × 1.50 m.)
(e) Fixed bridges	13 (3.30 m.)
(f) Tunnels	None
(g) Traction	Horse and tug. Unmetalled except through towns
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

The river is used to a small extent for navigation from Niort to the Bay of Biscay.

#### 85. *Charras Canal*

(a) Freycinet classification	Secondary
(b) Length	24 km.
(c) Depth	None
(d) Locks	Not stated
(e) Fixed bridges	Not stated
(f) Tunnels	Not stated
(g) Traction	None
(h) Tonnage (1936)	None
(i) Barge journeys (1936)	None

This canal, from the river Charente to St Jean-du-Breuil, is now disused and has been allowed to dry up.

#### 86. *River Charente*

(a) Freycinet classification	Main
(b) Length	110 km.
(c) Depth	Section (i) Sea to Rochefort, 6.30 m. (low tide); 7.80 m. (high tide). Section (ii) Rochefort to Cognac, 1.60 m. (min.); 2.00 m. (mean)
(d) Locks	3 (32 × 6.35 × 1.60 m.)
(e) Fixed bridges	7 (F)
(f) Tunnels	None
(g) Traction	Steam tug. Metalled towpath
(h) Tonnage (1936)	13,000
(i) Barge journeys (1936)	146

The river is classified as being navigationally first class as far as Port du Lys, but small barges can go as far as Cognac. The chief disadvantage is winter flooding and summer low water; the estuary winds a great deal and the tide runs out a long way, leaving a great expanse of mud and sand. Sea-going vessels drawing about 5 m. are able to reach Tonnay at the head of ocean navigation at high water. Smaller barges use the Charente à la Seudre Canal to avoid the passage through the port of Rochefort (see pp. 132-8).

The main upstream commodities are coal, phosphates and pyrites brought by sea; brandy and agricultural produce go downstream.

Ports	Km.	Wharves, factories, etc.
Bay of Biscay	0	
Rochefort	26	Port with shipbuilding yards (pp. 132-8)
Tonnay	32	Head of sea-going navigation. Wharves serving stone quarries
Saintes	76	Railway junction and depot
Cognac	110	Wharves. Brandy distilleries

### 87. *Charente à la Seudre Canal*

(a) Freycinet classification	Main
(b) Length	26 km.
(c) Depth	2.50 m.
(d) Locks	4 (F)
(e) Fixed bridges	3 (F)
(f) Tunnels	None
(g) Traction	Horse. 4.5 km. of towpath metalled, rest natural
(h) Tonnage (1936)	Included in return of R. Charente
(i) Barge journeys (1936)	Included in return of R. Charente

This canal provides an alternative route into the Charente waterway, thus avoiding the delays of the passage through the port of Rochefort. It starts from Marennes on the Biscay coast and runs to Tonnay.

### *Brouage Branch of the Charente à la Seudre Canal*

(a) Freycinet classification	Main
(b) Length	2 km.
(c) Depth	2.50 m.
(d) Locks	1 (F)
(e) Fixed bridges	None
(f) Tunnels	None
(g) Traction	As main canal
(h) Tonnage (1936)	Included in return of R. Charente
(i) Barge journeys (1936)	Included in return of R. Charente

This short branch provides an alternative outlet to the Biscay coast.



88. *River Garonne*

The navigable river may be divided into two sections.

	Section (i)	Section (ii)
(a) Freycinet classification	Secondary	Main
(b) Length	313 km.	150 km.
(c) Depth	0.25 m. (min.); 0.50 m. (max.)	(i) Coast to Bec d'Ambes, 4.10 m. (min.); 9.65 m. (mean) (ii) Bec d'Ambes to Castets, 1.80 m. (min.); 3.00 m. (mean)
(d) Locks	1 (30.65 × 6.00 × 2.00 m.)	None
(e) Fixed bridges	23 (F)	7 (N)
(f) Tunnels	None	None
(g) Traction	Chiefly downstream traffic with current	Tug. Metalled towpath
(h) Tonnage (1936)	1,385,000	Included in section (i)
(i) Barge journeys (1936)	47,496	Included in section (i)

The Garonne has few of the qualities of a navigable river. Its catchment area has scanty storage—very little permanent snow and ice in the Pyrenees and only a few small lakes. An extraordinarily steep drop on the French side of the Pyrenees and a predominance of impermeable rocks in the higher catchment basin result in a very rapid run-off, so that all the Pyrenean tributaries of the Garonne are violent and irregular in flow, bringing down much rock waste. The larger tributaries from the Central Massif have also little storage, and although they have the advantage of Atlantic rains they have long periods of low water in late summer. The coincidence of high water in Pyrenean and Central Massif headstreams produce severe floods.

The Garonne is classified as navigable between Roquefort in the department of Haute-Garonne and the Atlantic, a distance of 463 km., but it is only effectively navigable from Royan to Castets, where the lateral canal takes off. This part is tidal throughout, with a mean tidal amplitude of 4.50 m. in the neighbourhood of Bordeaux, decreasing steadily towards Castets. Above that place there are some difficult reaches owing to shifting gravel banks. Dredging has improved these passages and vessels can now pass on to the lateral canal at any time of the tide.

Above its maritime section, the Garonne is used only by small vessels. In 1936, for example, 32,923 downstream voyages were made, each vessel carrying an average of only 7 metric tons of stone, gravel, sand, etc., while the only upstream traffic comprised empty vessels. These figures may be compared with the section below

Nantes, where the number of voyages in 1936 was about 14,000, of which 8,000 were downstream, and each shipment averaged about 80 metric tons.

Ports	Km.	Wharves, factories, etc.
Pointe de Grave (Gironde)	0	Wharves
Pauillac (0.21 M.m.t.)	64	
Blaye (0.15 M.m.t.)	74	See pp. 139-53
Bordeaux (0.86 M.m.t.)	97	
Castets (end of effective river navigation)	150	

### 89. *Garonne Lateral Canal*

(a) Freycinet classification	Secondary
(b) Length	193 km.
(c) Depth	2.00 m.
(d) Locks	53 (30.65 m. long, others F)
(e) Fixed bridges	162 (3.60 m.)
(f) Tunnels	None
(g) Traction	Unmetalled towpath
(h) Tonnage (1936)	Included in return of Midi Canal
(i) Barge journeys (1936)	Included in return of Midi Canal

The Lateral Canal parallels the river Garonne from Castets to its junction with the Midi Canal at Toulouse. Its fortunes are largely bound up with those of the latter canal (see pp. 427-9), and for administrative purposes the canals are treated as one.

### *Branches of the Garonne Lateral Canal*

Five short branches link the Lateral Canal with the river Garonne and some of its tributaries.

	(i) Canal de Brienne (Garonne to Midi Canal)	(ii) Montauban branch (Montech to Montauban)	(iii) Descent to Tarn (Moissac to R. Tarn)
(a) Freycinet classification	Secondary	Secondary	Secondary
(b) Length	2 km.	11 km.	1 km.
(c) Depth	2.00 m.	2.00 m.	2.00 m.
(d) Locks	2 (30.65 m. long)	10 (30.65 m. long)	1 (30.65 m. long)
(e) Fixed bridges	3 (F)	9 (3.60 m.)	1 (F)
(f) Tunnels	None	None	None
(g) Traction	As for main canal	As for main canal	As for main canal
(h) Tonnage (1936)	Included in return of Midi Canal	Included in return of Midi Canal	Included in return of Midi Canal
(i) Barge journeys (1936)	Included in return of Midi Canal	Included in return of Midi Canal	Included in return of Midi Canal



	(iv) Descent to Garonne (Laboulbène to Beauregard)	(v) Descent to Boïse (Buzet to R. Boïse)
(a) Freycinet classification	Secondary	Secondary
(b) Length	5 km.	1 km.
(c) Depth	2.00 m.	2.00 m.
(d) Locks	2 (30.65 m. long)	1 (30.65 m. long)
(e) Fixed bridges	4 (F)	4 (F)
(f) Tunnels	None	None
(g) Traction	As for main canal	As for main canal
(h) Tonnage (1936)	Included in return of Midi C.	Included in return of Midi C.
(i) Barge journeys (1936)	Included in return of Midi C.	Included in return of Midi C.

### 90. *River Isle*

(a) Freycinet classification	Secondary
(b) Length	144 km.
(c) Depth	1.05 m. (min.); 2.00 m. (mean)
(d) Locks	40 (24.25 × 4.5 × 1.05 m.)
(e) Fixed bridges	40 (3.43 m.)
(f) Tunnels	None
(g) Traction	Steam tug. Unmetalled towpath
(h) Tonnage (1936)	Not stated
(i) Barge journeys (1936)	Not stated

The Isle is classed as navigable from Périgueux to its confluence with the Dordogne, but there is little traffic.

### 91. *River Dordogne*

(a) Freycinet classification	Secondary
(b) Length	133 km.
(c) Depth	Section (i) Mouth to Libourne, 2.00 m. (min.); 5.80 m. (mean). Section (ii) Above Libourne, 0.30 m. (min.); 1.10 m. (mean)
(d) Locks	None
(e) Fixed bridges	14 (F)
(f) Tunnels	None
(g) Traction	Horse and ox. Unmetalled towpath
(h) Tonnage (1936)	255,000
(i) Barge journeys (1936)	5,502

The Dordogne has a variable regime and the depth of water varies from about 30 cm. to 1.10 m. It is navigable under favourable conditions as far upstream as Bergerac. Barges of tonnage varying from 20 to 100 use the river according to the season.

### 92. *River Adour*

Although the Adour is classed as navigable for 134 km. from the Luy confluence to St Sever, navigation above the Midouze confluence is negligible. The Nive, which joins the Adour at Bayonne, is

navigable as far as Ustaritz. There are some downstream cargoes of limestone, for the iron and steel works, and of building stone.

(a) Freycinet classification	Main
(b) Length	134 km.
(c) Depth	Section (i) Mouth to Bec du Gave, 2.00 m. (min.); 3.50 m. (mean). Section (ii) Above Bec du Gave, 0.50 m. (min.); 1.20 m. (mean)
(d) Locks	None
(e) Fixed bridges	14 (F)
(f) Tunnels	None
(g) Traction	Horse and ox. Partially metalled towpath
(h) Tonnage (1936)	129,000
(i) Barge journeys (1936)	2,808

## THE VICHY REGIME

The demarcation line between occupied and unoccupied France was drawn so as to provide efficient communications along this line on the occupied side, while denying this facility to the Vichy government in the unoccupied side. A series of navigable waterways stretches across central France, near the armistice line, comprising the Rhône-Rhine Canal, the river Doubs, the river Saône to Chalon, the Burgundy Canal and the Marne-Saône Canal leading from the river Saône, and the Central Canal; the armistice line continues across the rivers Loire and Allier, leaving only their upper parts in the unoccupied territory. Thus a large part of the 9,700 km. of navigable waterways are under direct German control; only the Garonne Lateral Canal, the Midi Canal, the canals of the Rhône delta and the Rhône itself are in the unoccupied territory.

A certain amount of damage was done to the waterways in the north-east of France, where a number of bridges and locks had been blown up. There was little damage, however, to the canals themselves; the chief obstacle to the resumption of navigation was the amount of debris and numerous sunken barges in the beds of the waterways. By August, 1941, work had commenced on clearing the beds of the canals and of the rivers Seine, Marne and Oise, and in November it was announced that routes were clear between Paris and the north-eastern coalfield.

## BIBLIOGRAPHICAL NOTE

1. The official guide to the inland waterways of France is the *Guide de la Navigation Intérieure*, produced for the 'Office National de la Navigation' in Paris by the 'Librairie Berger-Levrault'. The latest edition, dated 1938, refers to conditions in 1936. It contains an alphabetical list of rivers, followed by one of canals, giving itineraries for each, and detailed information about locks, bridges, depths of water, etc.



2. Detailed statistics of the number of vessels using the waterways, and of the character and volume of goods conveyed, are contained in the *Statistique de la Navigation Intérieure*, published by the 'Direction des Voies Navigables et des Ports Maritimes' of the 'Ministère des Travaux Publics' in Paris, with the co-operation of the 'Office National de la Navigation'. The latest edition, dated 1938, supplies statistics referring to the year 1936.

3. Useful summaries and retrospective tables are given in the *Annuaire Statistique*, published by the 'Direction de la Statistique Générale et de la Documentation'. The latest available edition refers to 1938.

4. A brief summary of the navigable waterways is given yearly in *Didot-Bottin, Annuaire du Commerce, Tome I, Appendix: Liste des établissements et services rattachés aux administrations publiques: Canaux et rivières*.

5. A useful geographical summary is contained in H. Ormsby, *France*, Chapter XIV (London, 1931).

6. Numerous detailed and often well-illustrated articles have appeared in the following technical periodicals:

(a) French: *Génie Civil, Travaux* (formerly *Science et Industrie*) and *Annales des Ponts et Chaussées* (all at Paris). Special mention must be made of the 1934-5 edition of *Science et Industrie*, No. 254, entitled *Les Voies Navigables Françaises* which contains 316 pages of text, with 43 articles and many illustrations. Detailed articles on the Rhine are contained in the periodical *La Navigation du Rhin* (Strasbourg).

(b) English: *Modern Transport, Dock and Harbour Authority, Engineering, The Engineer*, and *Proceedings of the Institution of Civil Engineers* (all at London).

(c) German: *Wasser und Wegebau Zeitschrift, Verein Deutsche Ingenieure, Der Bauingenieur, Fördertechnik, Wasserstrassen Jahrbuch* and *Zeitschrift für Binnenschifffahrt* (all at Berlin).

## Appendix I

### CIVIL AVIATION (UP TO 1939)

#### *Relations with the state*

The general control of civil aviation in France is in the hands of the Ministry for Air, which was re-established as a separate ministry in 1928, and which also controls naval, military and colonial aviation. In 1933 it had become necessary for the state to take a much more active interest in civil aviation, owing to the inability of the air transport companies, in France as in other countries, to make a profit. This failure of air transport on the financial side occurred in spite of a steady increase in the number of passengers carried since 1929, without any great increase in the distances flown.

	Distance flown thousands of kilometres	No. of passengers carried	Mail carried tons	Freight carried tons
1921	2,353	9,427	10	166
1925	4,713	14,196	199	742
1929	9,380	25,289	143	1,602
1930	9,194	28,682	182	1,590
1931	9,268	34,238	192	1,685
1932	9,156	36,792	173	1,161
1933	9,988	51,110	233	1,512
1934	10,029	50,019	219	1,343
1935	10,051	61,596	272	1,320
1936	9,558	66,670	335	1,017
1937	10,505	89,076	437	1,217
1938	10,627	104,424	882	1,368

From *Annuaire Statistique*, 1938 Résumé Retrospectif, p. 106 (Paris, 1939)

These closer relations were effected through the granting of further subsidies, through the formation of a national air company in 1933 (*Air France*), and through the establishment in 1934 of an advisory committee on civil aviation to assist the Minister for Air.

#### *Recent expenditure on civil aviation, in millions of francs*

	Total civil aviation vote	Subsidies to <i>Air France</i>	Subsidies to <i>Air Afrique</i>	Total subsidies to companies
1936	175·6	135·3	13·2	148·5
1937	260·2	143·5	9·0	152·5*
1938	324·6	230·5	16·0	246·5†

\* A sum of 34·5 million francs was also included in the 1937 budget in respect of the 'Application of Social Laws' (i.e. cost of increases of pay, staff, etc.).

† Sums of 30 million and 95 million francs were also allotted for research and for material respectively to the North Atlantic service.



Economy in working following the amalgamation of the four existing companies permitted a reduction in the amount of the subsidy for a year or two, but owing to the fall in the value of the franc and to an increase in the number of services, it had later to be increased. Other expenditure is also borne by the state, which operates the air lines in North Africa, while the *Air Bleu* company, which operates the internal postal services, is entirely dependent for its revenue upon the state—its principal shareholder. In 1934 a commission was established to examine the achievements of the companies, and empowered to make recommendations regarding their operations and the subsidies paid. In 1935 committees were established to further the co-ordination of air transport, and other forms of transport, while at the same time the establishment of any new air service in France or in the colonies without government authority was prohibited. Indirect subsidies are also provided: for example, the state bears the cost of experimental work in the development of new aircraft.

### *Air France*

In 1933 the four chief air-transport companies were merged into the present national company, *Air France*, which also purchased the assets of the *Cie Générale Aeropostale* (then in liquidation). This merger allowed economy of working by a better utilization of machines—the large number of services operated by *Air France* was assured by no more than eighty-six machines. The company served thirty-seven countries over 40,000 km. of route to the principal cities of Europe and to the Far East and Africa, together with a postal service across the south Atlantic. In 1934 *Air France* formed a subsidiary to operate a mail service under contract with the Portuguese government from Lisbon to Tangier, where it made a connexion with the *Air France* line to South America. The table on p. 453 shows the company's traffic during 1938 and indicates the services which it operated and the wide extent of its activities.

There was also a service from Paris to Prague, operated by a Czecho-Slovak company, which made calls at Strasbourg.

The different services were, of course, of varying frequency. The Paris-London service ran four times daily, for example; the Paris-Marseilles-Algiers, the Paris-Marseilles-Ajaccio-Tunis and the Toulouse-Oran-Fez-Casablanca services were daily. The Dakar-Bamako service ran only weekly; while the Toulouse-Casablanca line continued to Dakar twice weekly to connect with the south Atlantic

Traffic carried by Air France, 1938

Line	Length km.	Distance flown on commercial service thousands of kilometres	No. of passengers carried*	Freight carried, not including baggage metric tons	Mail carried metric tons
Paris-London	350	991	31,919	313.9	67.6
Paris-Cologne-Berlin	910	312	3,736	11.9	24.9
Paris-Frankfurt-Berlin	945	59	970	3.8	6.1
Paris-Zurich	535	113	1,936	15.9	4.8
Paris-Amsterdam	470	211	4,467	66.5	9.6
Paris-Stockholm	1,660	148	668	3.7	0.4
Paris-Bucharest	2,280	1,232	9,559	176.9	36.8
Prague-Warsaw	535	155	1,310	22.1	2.8
Marseilles-Barcelona	430	279	2,425	134.8	52.2
Paris-Marseilles	715	1,007	13,642	14.4	31.5
Lyons-Geneva	125	73	1,849	18.9	6.6
Marseilles-Cannes	160	128	4,308	36.9	1.9
Marseilles-Ajaccio-Tunis	1,015	625	5,827	24.3	22.5
Marseilles-Algiers	835	509	4,520	83.0	65.6
Marseilles-Hanoi-Hongkong	13,765	1,463	1,420	21.4	27.6
Damascus-Bagdad	800	84	522	2.8	0.5
Toulouse-Oran-Fez-Casablanca	1,865	1,407	9,164	245.7	160.8
Casablanca-Santiago-da Chile	11,480	1,430	1,613	15.2	51.3
Total (regular lines)	38,875	10,226	99,855	1,341.7	859.4
Supplementary services					
Paris-Toulouse	635	69	638	5.7	20.1
Paris-Geneva (direct)	430	77	1,370	11.8	1.1
Paris-Bordeaux-Biarritz	695	100	967	3.2	—
Paris-Dinard-Jersey	405	10	450	1.9	—
Bordeaux-Toulouse	235	19	100	0.9	0.3
London-Le Touquet	165	19	647	2.5	—
Dakar-Kaolack-Bamako	1,200	107	397	0.3	0.6
Grand total, 1938	42,640	10,627	104,424	1,368.2	881.7†
Grand total, 1937	39,972	10,505	89,076	1,217.4	437.3

From *Annuaire Statistique*, 1938, p. 135 (Paris, 1939).

\* Of the total number of passengers carried 13,199 were carried free or were service personnel.

† The expansion of the postal traffic in 1938 arose from the abolition of the surtax on certain lines.



postal service. The Casablanca line also connected at Oran with a service operated by *Régie Air Afrique* from Tunis to Oran via Algiers.

The table on p. 453 demonstrates that nearly one-third of the passengers carried by *Air France* travelled on the London-Paris service. Passenger traffic to other European cities was comparatively limited, for it had to be shared with many other national companies.

*The Far East Service.* The Paris-Hanoi service operated weekly. In 1935, by agreement with the China National Aviation Corporation (of which the shareholders were Pan-American Airways and the Chinese Government), the Chinese air-line system was extended to Hanoi, and thus *Air France* was able to secure the carriage of the entire Chinese air mail to Europe. In 1938 an extension was made to Hongkong, which could be reached from Marseilles in  $6\frac{1}{2}$  days. In 1938 a second weekly service was established from Marseilles to Damascus, connecting with the weekly Damascus-Bagdad service created in 1937. During the winter of 1938-9 the route taken by this second service was altered to follow the north coast of Africa to Cairo and thence to Damascus.

*South Atlantic.* A postal service to Natal, Brazil, with a steamer crossing of the sea, was begun as early as 1928. In 1934 an agreement to share the traffic was made with the German interests operating a zeppelin and aeroplane service. From 1935 the French service was operated by air all the way, and in 1936 the bi-weekly service was made weekly. In 1936, with the opening of a passenger service to Dakar, *Air France* opened a passenger service between Buenos Aires and Santiago da Chile, but the transatlantic section had not been opened to passengers. With the putting in service of a fleet of new Lioré flying boats, passenger traffic was likely soon to have been carried. In 1939 negotiations were in progress with the *Lufthansa* concerning the doubling of the services.

*North Atlantic.* *Air France Transatlantique* was formed in 1937, with a capital of 4 million francs, by *Air France* and the *Compagnie Générale Transatlantique* with government collaboration; the state reserved the right to acquire 55 % of the shares. The object of the new company was to make preliminary investigations for a proposed air service across the north Atlantic. France had been overtaken in this field by *Imperial Airways* and *Pan-American Airways*. At first, the Azores-Bermuda route was decided upon, but following a trial flight in 1938 by the *Lieutenant de Vaisseau Paris*, it was possible to contemplate a direct crossing between the Azores and New York. In 1938 a strictly reciprocal agreement to permit French use of

landing rights in the Azores was made with the United States government, which had, with *Imperial Airways*, secured permission to call in 1937. Preparations for this service, however, were delayed by an inability to secure the necessary long-distance aircraft and suitable landing grounds. It was proposed to use as starting points the flying-boat base at Biscarrosse in the Landes and an aeroplane landing ground at Bordeaux. During 1938 and 1939 trial flights were also conducted over the Lisbon-Azores-New York route.

*Co-operation with other air-transport companies.* A considerable degree of co-operation existed between *Air France* and other companies whose services touched upon its own; agreements existed between *Air France* and both the Belgian *Sabena* and the Czechoslovak government, while other agreements were made over services to Italy, Spain and China. Close connexions existed between *Air France* and the *Lufthansa* over the South American service, and over the establishment of a pool for the Paris-Berlin services. More recently negotiations took place between the French and German authorities providing for technical collaboration over the north and south Atlantic services and the use of certain French aerodromes in North and West Africa, and also for closer co-operation on the services to the East and Far East.

### *Other Companies*

Besides *Air France* there were three other companies operating in 1939, covering the specialized fields of (i) west and central African traffic, and (ii) postal services within France.

*Régie Air Afrique.* In 1935 this company opened a service on the Algiers-Congo route (Algiers-Banqui-Brazzaville), which was soon extended to Broken Hill to connect with the Madagascar services started in 1935. In 1936 the company took over the Tunis-Algiers-Oran route, which connected with the Toulouse-Oran-Casablanca-Dakar-South American line (daily Tunis-Algiers and three times weekly Algiers-Oran). *Régie* also maintained a daily service between Bône and Constantine; a bi-weekly service between Algiers and Antananarivo; and a weekly service between Dakar and Pointe-Noire (French Equatorial Africa). The line to Brazzaville and Madagascar was operated in a pool with the Belgian *Sabena*. In 1937 subsidies received amounted to 9.75 and 16 millions. Traffic on the *Régie* lines in 1936 amounted to 363 passengers, 8.9 tons of mail and 2.5 tons of goods. The line was difficult to work and most passengers travelled for short journeys only, but the ratio of receipts to ex-



penditure was stated to bear comparison with the figure shown by *Air France*.

*Compagnie Aero-Maritime*. The only non-subsidized line, this company began as a subsidiary of the *Chargeurs Réunis* shipping company. In 1935 it began a weekly service between Cotonou (Dahomey) and Niamey (Niger Province, French West Africa) in the Algiers-Madagascar service, and in 1937 established a service between Contonou and Dakar to make a connexion with the South American service. The service was later extended to Pointe-Noire (French Equatorial Africa), operated by flying boats. Although this company enjoyed low overhead expenses, it eventually seemed to be in need of a subsidy.

*Compagnie Air Bleu*. In 1935 this company began to run postal services from Paris to the leading cities of France, but although the technical results were excellent the services were unprofitable. In 1937 the concern was reconstituted: as a result the majority of the shares came to be held by the state, which had a voice in the management of the company. By 1938 the following air postal services were in operation: Paris-Bordeaux-Mont-de-Marsan; Paris-Toulouse-Perpignan; Paris-Clermont Ferrand-St Etienne-Lyons-Grenoble, and Paris-Lyons-Marseilles-Nice.

### *Airports aid Civil Aerodromes*

The principal civil aerodromes are shown in the following table:

#### *Traffic at Aerodromes, 1938, arising from Air Transport Services*

Aerodrome	Plane arrivals and departures	Passengers arriving and departing		Mail metric tons		Freight and excess baggage metric tons	
		Fare-paying	Free	Departing	Arriving	Departing	Arriving
Le Bourget	20,952	62,297	14,970	397.3	420.9	972.2	772.2
Marseilles	9,039	15,377	3,576	232.6	171.1	134.5	39.9
Lyons	4,398	1,842	550	64.6	26.9	24.8	7.0
Toulouse	2,676	3,637	1,087	63.2	71.2	101.0	19.2
Strasbourg	1,998	2,095	231	2.2	3.1	15.8	14.6
Bordeaux	1,668	397	301	12.9	20.2	1.1	0.5
Ajaccio	1,236	2,623	240	2.5	3.7	1.5	8.6
Tunis	2,353	10,916	829	11.3	11.7	7.5	19.6
Oran	1,849	2,846	165	4.7	6.4	32.7	5.7
Algiers	1,602	6,917	600	22.9	21.5	21.7	20.4
Casablanca	1,125	3,636	845	30.8	26.2	17.5	12.2

From *Annuaire Statistique*, 1938, p. 135 (Paris, 1939).

Passengers, mail and freight referred to in this table are only those for which the aerodrome under which they are entered was the point of origin or destination.

'Freight' does not include baggage carried free.

(In the 'plane' and 'passenger' columns the numbers of departures and arrivals are very nearly equal)

The principal airport is Le Bourget near Paris, where extensive improvements were being carried out. Next was Marignane, 25 km. from Marseilles, on the Etang de Berre, which caters for sea-planes and flying boats as well as aeroplanes. It is an important point on the routes to North Africa and the Far East, and is used also by German, Italian and Belgian lines. Developments in hand included the improvement of the water-landing facilities. The airports at Lyons and Strasbourg have a considerable traffic because they are intermediate points on busy services. More interest attaches to the principal airports of the south-west—Bordeaux and Toulouse. With the progress of French and American experiments for a transatlantic service, Bordeaux appears likely to become of increasing importance. The older airport is at Teynac, but the new airport at Marignac, opened in 1937, is the scene of most development. The airport of Toulouse is the terminal point of the service to Casablanca and South America, and large quantities of mail and passengers pass through the port regularly. The aerodrome at Franczal is being given up to military use and a new site is being developed at Blagnac, 5 km. to the east of the city.

The changes in design of aircraft, the increase in their size and capacity, and the progress of flying technique in general, all demand constant development and improvement of landing facilities. A considerable programme was launched in 1936, providing for the laying out of ten new large airports, the improvement of eighty existing ones, and the creation of 280 new landing grounds. The eventual cost of the scheme was to be 612 million francs, of which sum, however, only a small part had been allocated by 1939. At the end of 1937 there were 400 civil aerodromes in metropolitan France, of which forty-nine were owned by the state and 124 by bodies like chambers of commerce and flying clubs. In recent years the number of state-owned aerodromes has not greatly increased, but other civil aerodromes have increased rapidly in number. Three state-owned aerodromes—Bordeaux, Lyons and Marseilles—are administered by the local chambers of commerce. Various improvements in flying facilities have been made; at the end of 1937 airports in France and North Africa were equipped with 117 beacons and flying was aided by thirty-five wireless stations.

### *Private Flying*

In an endeavour to stimulate the development of private flying a system of bounties for the purchase and upkeep of private machines



was in operation from 1930 to 1936, but was discontinued as the results were disappointing. The grants to help flying clubs were continued, however, and 3,250,000 francs were allocated in 1937 for this purpose. At the end of 1936 a new movement was initiated, *l'aviation populaire*. The scheme provided pre-military flying training for those under 21; machines and instruction were provided by the Ministry for War. Pupils between the ages of 14 and 17 received the theoretical training in aeronautics, and also gliding practice, while those between 17 and 21 were given training in aeroplanes up to the standard of a military pilot. A proportion of those who secured pilots certificates in this way were allowed to do a proportion of their military service in the air force, and thus a reserve of pilots was built up. In 1937 expenditure on *l'aviation populaire* was 48 millions, with another 14 millions for military training under this head; in 1938 the figures were 12 and 23 millions respectively. In the first eighteen months 153 training centres were started and 1,121 pilots certificates were obtained by pupils in 1937. In June 1938 the number of aircraft devoted to this movement was reported to be 536, out of a total of 2,683 non-military planes in France. This total also included 768 privately owned machines.

## Appendix II

### POSTS, TELEGRAPHS AND TELEPHONES

The postal, telephone and land-telegraph services are operated by the state; submarine cables and wireless telegraphy and telephony are operated chiefly by the state, but also by private companies; the broadcasting system is operated by the state, but there are a number of private stations as well.

#### POSTAL SERVICES

A general rule of the French postal service is that a letter posted anywhere in France shall be delivered to its destination no later than the following day. The internal air postal service was established to further this aim, and mail is forwarded by air, by road or by train, according to requirements of time. In 1937, abolition of the surcharge on mails carried by the internal air services led to an expansion of the quantity carried, and during the last six months of 1937 the amount was 70 tons.

The equipment and working of the postal services in 1937 may be summarized as follows:

No. of post offices	17,114
No. of letter boxes	106,881
Total no. of dispatches (of which 1686.5 million were ordinary letters)	5,707 million
Receipts from postal services	1,945 million francs

The working budget of the post office, in 1937, for all services, including broadcasting, was as follows:

Receipts	Million francs	Expenditure	Million francs
From postal services	1945.3	Central administration	16.3
„ telegraphs	259.3	Salaries for working and mechanical services	3070.0
„ broadcasting	219.7	Buildings	235.5
„ telephones	1578.4	Operation of broadcasting service	80.2
„ financial services	211.8	Transport	203.4
		Other expenses	616.7
Total	4214.5	Total	4222.1



For some years the administration of the postal service has been organized on a regional basis, and is operated through eighteen postal regions (see Fig. 123).



Fig. 123. Post Office regions, 1933

Based on the *Atlas de France*, plate 69 (Paris, 1933).

*Postal Cheques.* The postal cheque system in France is a somewhat more elaborate means of transmitting payments than the English postal order. Instituted in 1918, it has continued to make progress and is now firmly embedded in the commercial life of the country, forming a cheap, speedy and secure means of settling ordinary accounts at a distance. In 1937 there were 755,826 accounts, with credit balances of 5,187 million francs; 137.7 million transactions were effected, amounting to 615 milliard francs. Each of the eighteen separate postal regions has its central postal cheque office.

## TELEGRAPHS AND TELEPHONES

Almost every commune in France possesses a telegraph and telephone service. All main telegraph and telephone lines run on one side of the railway, the roads being used only for cross-country routes; the railway telegraph service uses the other side of the railway, the two routes normally being never combined. In all the larger towns the lines are underground.

Development of the telephone service continues, although the number of instruments in use is low for the size of the country; in 1937 there were 1,499,000 instruments in use. At the end of 1936 the country possessed 1 telephone for every 29 inhabitants, compared with 1 telephone for every 7 inhabitants in U.S.A. (1935) and 1 for every 16 in the United Kingdom (1935). Recent improvements have been made in the direction of laying overhead wires underground. Cables between Trappes and Le Mans, Altkirch and Basle, Marseilles and Marignane were put into service in 1937, and others were under construction. The lines from Lyons to Marseilles and from Paris to Nancy and Strasbourg have been doubled. The installation of automatic exchanges proceeds, and considerable schemes are on foot for converting one-half of the rural exchanges to automatic working. In the development of automatic exchanges, France is less advanced than several countries. There are 61 in the Paris region.

The telegraph and telephone equipment of the country in 1937 may be summarized as follows:

*Telegraphs*

	km.
Length of line, overhead wires	369,527
Length of appropriated circuits	75,800
Length of long distance submarine cables	36,111
Length of coastal cables	1,852
No. of telegraph stations:	
Open continuously	19
Open for long periods	1,288
Open for limited periods	38,456

*Telephones*

	km.
Length of lines, overhead	168,122
Length of lines, underground, urban	247,753
Length of lines, underground, long distance	10,465
Length of wire, above and below ground	9,381,201
No. of telephone exchanges	27,600



## SUBMARINE CABLES

France is dependent upon British cables for communication with Indo-China, Madagascar and the smaller colonies, but improvements in wireless telegraphy have made the laying of any long-distance additions unlikely.

The French government operated the following cables in 1939:

(1) Short coastal cables, chiefly those connecting the mainland with the various islands off the coast. In 1938 there were sixty-nine of these, of which the earliest had been laid in 1865 and the most recent in 1936. The majority were single-wire cables, although a number contained two or four wires. This group included two cables to Corsica: Antibes-St Florent and Toulon-Ajaccio; and two mainland coastal cables, both laid in 1914, Brest-Cherbourg and Cherbourg-Dunkirk.

(2) A colonial and international network, comprising twenty-seven cables, as follows:

Marseilles-Algiers (3)	Lomé-Duala (Cameroons)
Marseilles-Philippeville (Algeria)	Cotonou-Libreville (French Equatorial Africa)
Marseilles-Oran (Algeria) (2)	Libreville-Pointe-Noire (French Equatorial Africa):
Marseilles-Bizerta (Tunisia) (3)	(a) Libreville-Cape Lopez
Oran-Tangier	(b) Cape Lopez-Pointe-Noire
Menton-Genoa	Tamatave (Madagascar)-Réunion
Machinaggio (Corsica)-Leghorn	Réunion-Mauritius
Bonifacio (Corsica)-St Teresa (Sardinia)	Brest-New York
Brest-Casablanca	(a) Brest-Azores
Brest-Dakar	(b) Azores-New York
Casablanca-Dakar	Nabeul (Tunisia)-Igalo (Yugo-Slavia)
Dakar-Conakry (French Guinea)	Nabeul-Beyrout (Syria)
Grand Bassam (Ivory Coast)-Cotonou (Dahomey)	
Lomé (Togoland)-Cotonou	

All these cables were single wire; the most recent were those from Marseilles-Bizerta (1938), Tunisia-Yugo-Slavia (1936) and Tunisia-Beyrout (1938). In 1939 allocations had been made for the laying of further cables: Marseilles-Oran and Marseilles-Bizerta.

(3) Cross-Channel cables, numbering thirteen, of which the latest was laid in 1933. These were mostly four-wire, though there were two of twenty-eight and one of seventy-six wires.

Two private companies operated cables as follows:

*Compagnie française des Câbles télégraphiques*, ten cables

Brest-St Pierre (St Pierre and Miquelon)	Cape Cod-New York
St Pierre-Cape Cod (Massachusetts)	St Thomas (French West Indies)-
St Pierre-Canso (Canada)	Martinique
Brignogan (Brittany)-Porthcurno	Martinique-Paramaibo (Dutch Guiana)
(Cornwall) (2)	Paramaibo-Cayenne (French Guiana)
Brest-Cape Cod	Martinique-Guadeloupe

*Compagnie des Câbles Sud-Américains*, four cables

Dakar-Isle of Fernando de Noronha	Conakry (French Guinea)-Monrovia
(off north-east Brazil)	(Liberia)
Fernando de Noronha-Pernambuco	Monrovia-Grand Bassam (Ivory
(Brazil)	Coast)

These private cables were all single wire.

## WIRELESS TELEGRAPHS AND TELEPHONES

(1) International and colonial wireless services (government and commercial) are worked by stations at St Assise, Croix d'Hins, Lyons, St Pierre des Corps and Villeban, all of which are state-owned save St Assise. A powerful station has recently been opened at St Nazaire for communication with America.

(2) The colonial wireless service permits direct communication between France and every important French possession.

(3) Aero-radio stations. France is divided into a number of territorial districts for the aeronautical security service. Each district is controlled by a principal aeronautical and direction-finding station, assisted by a number of auxiliary stations. The principal stations are at Ajaccio and Bastia (Corsica), Bordeaux, Le Bourget, Dijon, Lyons, Marignane (near Marseilles), Nancy, Toulouse and Tours. In 1939 the auxiliary stations numbered forty-five, of which thirty-nine were in France, five were in North Africa, and one was in Corsica.

Radio communication in recent years has been marked by technical advances and the improvement of facilities rather than by any large programme. Wireless telephony has developed, for example, direct connexions having been established with Russia and Japan in 1935, and with U.S.A. in 1936.



## BROADCASTING

While the state, through the P.T.T. (*Postes, Télégraphes, Téléphones*) organization, operates a comprehensive broadcasting service, it claims no monopoly. Private stations have been working for some years, although there is a tendency for the state service increasingly to take over the private stations. The P.T.T. stations, which in 1939 numbered fourteen, were situated at Paris (Paris-P.T.T., Tour Eiffel, Radio-Paris), Bordeaux, Grenoble, Lille, Limoges, Lyons, Marseilles, Montpellier, Nice, Rennes, Strasbourg and Toulouse. The private stations numbered fourteen, and were situated at Paris (Poste Parisien, Poste de l'Ile de France, Radio-Cité, Rueil-Malmaison), Agen, Béziers, Bordeaux, Caudebec-en-Caux, Juan-les-Pins, Lyons, Montpellier, Nice, Nîmes, and Toulouse.

A powerful station operates at Paris for broadcasts to the colonies.

*Broadcasting since 1940.* Since the Occupation broadcasting has been controlled by the German High Command, under which the broadcasting stations in the Occupied Zone function. In Unoccupied France five stations of the national system operate—Grenoble, Limoges, Marseilles, Montpellier and Toulouse. The private stations now operating number only six—Agen, Juan-les-Pins, Lyons, Montpellier, Nîmes, Toulouse.

## NOTE ON TIME

The standard time adopted in France, as in Belgium and Spain, is that of the Meridian of Greenwich.

One hour of 'Summer Time' is observed from the last Saturday in March, or if that comes before Easter, the Saturday following Easter, until the first Saturday in October.

After July 1940 the occupied zone followed Central European clock time, i.e. in the occupied zone, Summer Time was two hours ahead of Greenwich Mean Time.

In the unoccupied zone, arrangements were altered several times until, on November 1st 1942, they were brought into line with those of the occupied zone.

For the times of sunrise and sunset, duration of twilight, and times of moonrise and moonset, the *Nautical Almanac* should be consulted.

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## METRIC AND BRITISH UNITS

It is customary to think of the 'metre' and the 'yard' as representing unalterable units of length. This is not so. The metre was originally intended to be the 10,000,000th part of the earth's meridional quadrant. But the accurate determination of this length proved to be extremely difficult—partly for technical reasons, and partly because of different conceptions of the 'figure of the earth'. In view of these difficulties it became necessary to define the length of the metre in terms of suitable metal bars measured under specified conditions of temperature, pressure, humidity, etc. Similar standard bars were also used to define the length of other units such as the yard. As all these metallic standards are subject to change, conversion tables differ according to the date of comparison between different bars. The tables that follow are based on the comparison between the yard and the metre made in 1895. This made 1 metre equivalent to 39·370113 inches.

The first five tables provide the ratios between units of the same kind, e.g. length, area, etc. For convenience in printing, negative powers of 10 have been used to indicate very small fractions, instead of the decimal system. Thus the figure 0·00000032 becomes  $3·2 \times 10^{-7}$ ; the first significant figure is the *seventh* after the decimal point. Conversely,  $7·34 \times 10^{-5}$  becomes 0·0000734.

Tables 6–18 give more fully the ratios between metric units and their equivalent British units. Metric digits (0 to 9) are printed in italics at the top of each table, reading horizontally from left to right. Metric tens, likewise in italics, read vertically from top to bottom on the left of the table. Thus, in Table 6, to convert 87 centimetres into inches, read 8 down on the left, then move horizontally to the right to the 7 digit column, where the answer 34·252 is read.

*Metric System. List of Prefixes*

Deca means ten times.

Deci means a tenth part of.

Hecto means a hundred times.

Centi means a hundredth part of.

Kilo means a thousand times.

Milli means a thousandth part of.

In abbreviations the Decametre, etc., is Dm., and the decimetre, etc., dm.

*Note on 'Nautical', 'Geographical' and 'Statute' miles*

A British 'nautical mile' is the length of the minute of the meridian at any given latitude, and is therefore a variable unit. It is given in feet for Clarke's 1880 spheroid by the formula

$$60771·1 - 30·7 \cos 2 \text{ Lat.}$$

This is the sea mile of the scale of latitude and distance of the Admiralty Charts. From the above formula it will be found to vary from 6,046·4 ft. at the equator to 6,107·8 ft. at the poles, being 6,077·1 ft. at latitude  $45^\circ$ .

The so-called 'international nautical mile' of 1,852 m. or 6,076 ft. is the length of the minute of the meridian at latitude  $45^\circ$  on the International Spheroid. This corresponds to the 6,077 ft. for Clarke's spheroid.

A 'geographical mile' is a fixed unit, being defined by some as the length of a minute of the equator and by others as that of the minute of the meridian at latitude  $45^\circ$ . According to the former definition its value on Clarke's spheroid is 6,087 ft. and according to the latter 6,077 ft. The round figure 6,080 is usually adopted for the purposes of ordinary navigation.

The British 'statute mile' measures 5,280 ft.

Table 1. Length

Nautical mile	Statute mile	Kilometre	Metre	Yard	Foot	Inch	Centimetre
<i>I</i>	<i>I</i> ·152	<i>I</i> ·853	<i>I</i> 853	2027	6080*	72,960	185,300
8·684 × 10 <sup>-1</sup>	<i>I</i>	<i>I</i> ·60934	1609·34	1760	5280	63,360	160,934
5·396 × 10 <sup>-1</sup>	6·21372 × 10 <sup>-1</sup>	<i>I</i>	1000	1093·61	3280·84	39,370·1	100,000
5·396 × 10 <sup>-4</sup>	6·21372 × 10 <sup>-4</sup>	1·0 × 10 <sup>-3</sup>	<i>I</i>	1·09361	3·28084	39·3701	100
4·934 × 10 <sup>-4</sup>	5·68182 × 10 <sup>-4</sup>	9·14399 × 10 <sup>-4</sup>	9·14399 × 10 <sup>-1</sup>	<i>I</i>	3	36	91·4399
1·645 × 10 <sup>-4</sup>	1·89394 × 10 <sup>-4</sup>	3·048 × 10 <sup>-4</sup>	3·048 × 10 <sup>-1</sup>	3·33333 × 10 <sup>-1</sup>	<i>I</i>	12	30·48
1·371 × 10 <sup>-5</sup>	1·57828 × 10 <sup>-5</sup>	2·54 × 10 <sup>-5</sup>	2·54 × 10 <sup>-2</sup>	2·77778 × 10 <sup>-2</sup>	8·33333 × 10 <sup>-2</sup>	<i>I</i>	2·54
5·390 × 10 <sup>-6</sup>	6·21372 × 10 <sup>-6</sup>	1·0 × 10 <sup>-5</sup>	1·0 × 10 <sup>-2</sup>	1·09361 × 10 <sup>-2</sup>	3·28084 × 10 <sup>-2</sup>	3·93701 × 10 <sup>-1</sup>	<i>I</i>

\* This is the customary British practice, and not the 'international nautical mile,' which Great Britain has not adopted.

Table 2. Area

Square mile	Square kilometre	Hectare	Acre	Square metre	Square yard
<i>I</i>	2·58998	258·998	640	258,998 × 10	30,976 × 10 <sup>2</sup>
3·86103 × 10 <sup>-1</sup>	<i>I</i>	100	247·106	1,000,000	119,599 × 10
3·86103 × 10 <sup>-3</sup>	1·0 × 10 <sup>-2</sup>	<i>I</i>	2·47106	10,000	11,959·9
1·5625 × 10 <sup>-3</sup>	4·04685 × 10 <sup>-3</sup>	4·04685 × 10 <sup>-1</sup>	<i>I</i>	4046·85	4840
3·86103 × 10 <sup>-7</sup>	1·0 × 10 <sup>-6</sup>	1·0 × 10 <sup>-4</sup>	2·47106 × 10 <sup>-4</sup>	<i>I</i>	1·19599
3·22831 × 10 <sup>-7</sup>	8·36126 × 10 <sup>-7</sup>	8·36126 × 10 <sup>-5</sup>	2·06612 × 10 <sup>-4</sup>	8·36126 × 10 <sup>-1</sup>	<i>I</i>

Table 3. Yield per Unit Area

Tons per acre	Metric tons per hectare	Quintals per hectare
<i>I</i>	2·51071	25·1071
3·98294 × 10 <sup>-1</sup>	<i>I</i>	10
3·98294 × 10 <sup>-2</sup>	1·0 × 10 <sup>-1</sup>	<i>I</i>



Table 4. *Volume and Capacity*

Kilolitre	Cubic metre	Cubic yard	Bushel	Cubic feet	Imp. gall.	Litre	Pint
<i>I</i>	<i>I</i> ·000027	<i>I</i> ·30799	27·4969	35·3157	219·976	1000	1759·80
$9\cdot99973 \times 10^{-1}$	<i>I</i>	<i>I</i> ·30795	27·4962	35·3148	219·970	999·973	1759·75
$7\cdot64532 \times 10^{-1}$	$7\cdot64553 \times 10^{-1}$	<i>I</i>	21·0223	27	168·178	764·532	1345·43
$3\cdot63677 \times 10^{-2}$	$3\cdot63687 \times 10^{-2}$	$4\cdot75685 \times 10^{-2}$	<i>I</i>	1·28435	8	36·3677	64
$2\cdot83160 \times 10^{-2}$	$2\cdot83167 \times 10^{-2}$	$3\cdot70370 \times 10^{-2}$	$7\cdot78602 \times 10^{-1}$	<i>I</i>	6·22882	28·3160	49·8306
$4\cdot54596 \times 10^{-3}$	$4\cdot54608 \times 10^{-3}$	$5\cdot94607 \times 10^{-3}$	$1\cdot25 \times 10^{-1}$	$1\cdot60544 \times 10^{-1}$	<i>I</i>	4·54596	8
$1\cdot0 \times 10^{-3}$	$1\cdot000027 \times 10^{-3}$	$1\cdot30799 \times 10^{-3}$	$2\cdot74969 \times 10^{-2}$	$3\cdot53157 \times 10^{-2}$	$2\cdot19976 \times 10^{-1}$	<i>I</i>	1·75980
$5\cdot68245 \times 10^{-4}$	$5\cdot68260 \times 10^{-4}$	$7\cdot43258 \times 10^{-4}$	$1\cdot5625 \times 10^{-2}$	$2\cdot00680 \times 10^{-2}$	$1\cdot25 \times 10^{-1}$	$5\cdot68245 \times 10^{-1}$	<i>I</i>

Table 5. *Weight*

'Ton	Metric ton or Millier	Quintal	Kilogram	lb.
<i>I</i>	<i>I</i> ·01605	10·1605	1016·05	2240
$9\cdot84207 \times 10^{-1}$	<i>I</i>	10	1000	2204·62
$9\cdot84207 \times 10^{-2}$	$1\cdot0 \times 10^{-1}$	<i>I</i>	100	220·452
$9\cdot84207 \times 10^{-4}$	$1\cdot0 \times 10^{-3}$	$1\cdot0 \times 10^{-2}$	<i>I</i>	2·20462
$4\cdot46429 \times 10^{-4}$	$4\cdot53592 \times 10^{-4}$	$4\cdot53592 \times 10^{-3}$	$4\cdot53592 \times 10^{-1}$	<i>I</i>

Table 6. Centimetres to Inches

1 cm. = 0.393701 in.

	0	1	2	3	4	5	6	7	8	9
—	—	0.394	0.787	1.181	1.575	1.969	2.362	2.756	3.150	3.543
1	3.937	4.331	4.724	5.118	5.512	5.906	6.299	6.693	7.087	7.480
2	7.874	8.268	8.661	9.055	9.449	9.843	10.236	10.630	11.024	11.417
3	11.811	12.205	12.598	12.992	13.386	13.780	14.173	14.567	14.961	15.354
4	15.748	16.142	16.535	16.929	17.323	17.717	18.110	18.504	18.898	19.291
5	19.685	20.079	20.472	20.866	21.260	21.654	22.047	22.441	22.835	23.228
6	23.622	24.016	24.409	24.803	25.197	25.591	25.984	26.378	26.772	27.165
7	27.559	27.953	28.346	28.740	29.134	29.528	29.921	30.315	30.709	31.102
8	31.496	31.890	32.283	32.677	33.071	33.465	33.858	34.252	34.646	35.039
9	35.433	35.827	36.220	36.614	37.008	37.402	37.795	38.189	38.583	38.976
10	39.370									

Table 7. Metres to Feet

1 m. = 3.28084 ft.

	0	1	2	3	4	5	6	7	8	9
—	—	3.3	6.6	9.8	13.1	16.4	19.7	23.0	26.3	29.5
1	32.8	36.1	39.4	42.7	45.9	49.2	52.5	55.8	59.1	62.3
2	65.6	68.9	72.2	75.5	78.7	82.0	85.3	88.6	91.9	95.1
3	98.4	101.7	105.0	108.3	111.6	114.8	118.1	121.4	124.7	128.0
4	131.2	134.5	137.8	141.1	144.4	147.6	150.9	154.2	157.5	160.8
5	164.0	167.3	170.6	173.9	177.2	180.5	183.7	187.0	190.3	193.6
6	196.9	200.1	203.4	206.7	210.0	213.3	216.5	219.8	223.1	226.4
7	229.7	232.9	236.2	239.5	242.8	246.1	249.3	252.6	255.9	259.2
8	262.5	265.8	269.0	272.3	275.6	278.9	282.2	285.4	288.7	292.0
9	295.3	298.6	301.8	305.1	308.4	311.7	315.0	318.2	321.5	324.8
10	328.1	331.4	334.6	337.9	341.2	344.5	347.8	351.0	354.3	357.6



Table 7 (continued). Metres to Feet

	0	1	2	3	4	5	6	7	8	9
11	360.9	364.2	357.5	370.7	374.0	377.3	380.6	383.9	387.1	390.4
12	393.7	397.0	400.3	403.5	406.8	410.1	413.4	416.7	419.9	423.2
13	426.5	429.8	433.1	436.4	439.6	442.9	446.2	449.5	452.8	456.0
14	459.3	462.6	465.9	469.2	472.4	475.7	479.0	482.3	485.6	488.8
15	492.1	495.4	498.7	502.0	505.2	508.5	511.8	515.1	518.4	521.7
16	524.9	528.2	531.5	534.8	538.1	541.3	544.6	547.9	551.2	554.5
17	557.7	561.0	564.3	567.6	570.9	574.1	577.4	580.7	584.0	587.3
18	590.6	593.8	597.1	600.4	603.7	607.0	610.2	613.5	616.8	620.1
19	623.4	626.6	629.9	633.2	636.5	639.8	643.0	646.3	649.6	652.9
20	656.2	659.4	662.7	666.0	669.3	672.6	675.9	679.1	682.4	685.7
21	689.0	692.3	695.5	698.8	702.1	705.4	708.7	711.9	715.2	718.5
22	721.8	725.1	728.3	731.6	734.9	738.2	741.5	744.8	748.0	751.3
23	754.6	757.9	761.2	764.4	767.7	771.0	774.3	777.6	780.8	784.1
24	787.4	790.7	794.0	797.2	800.5	803.8	807.1	810.4	813.7	816.9
25	820.2	823.5	826.8	830.1	833.3	836.6	839.9	843.2	846.5	849.7
26	853.0	856.3	859.6	862.9	866.1	869.4	872.7	876.0	879.3	882.5
27	885.8	889.1	892.4	895.7	899.0	902.2	905.5	908.8	912.1	915.4
28	918.6	921.9	925.2	928.5	931.8	935.0	938.3	941.6	944.9	948.2
29	951.4	954.7	958.0	961.3	964.6	967.8	971.1	974.4	977.7	981.0
30	984.3	987.5	990.8	994.1	997.4	1000.7	1003.9	1007.2	1010.5	1013.8
31	1017.1	1020.3	1023.6	1026.9	1030.2	1033.5	1036.7	1040.0	1043.3	1046.6
32	1049.9	1053.1	1056.4	1059.7	1063.0	1066.3	1069.6	1072.8	1076.1	1079.4
33	1082.7	1086.0	1089.2	1092.5	1095.8	1099.1	1102.4	1105.6	1108.9	1112.2
34	1115.5	1118.8	1122.0	1125.3	1128.6	1131.9	1135.2	1138.5	1141.7	1145.0
35	1148.3	1151.6	1154.9	1158.1	1161.4	1164.7	1168.0	1171.3	1174.5	1177.8
36	1181.1	1184.4	1187.7	1190.9	1194.2	1197.5	1200.8	1204.1	1207.3	1210.6
37	1213.9	1217.2	1220.5	1223.8	1227.0	1230.3	1233.6	1236.9	1240.2	1243.4
38	1246.7	1250.0	1253.3	1256.6	1259.8	1263.1	1266.4	1269.7	1273.0	1276.2
39	1279.5	1282.8	1286.1	1289.4	1292.7	1295.9	1299.2	1302.5	1305.8	1309.1
40	1312.3	1315.6	1318.9	1322.2	1325.5	1328.7	1332.0	1335.3	1338.6	1341.9

Table 7 (continued). Metres to Feet

	0	1	2	3	4	5	6	7	8	9
41	1345.1	1348.4	1351.7	1355.0	1358.3	1361.5	1364.8	1368.1	1371.4	1374.7
42	1378.0	1381.2	1384.5	1387.8	1391.1	1394.4	1397.6	1400.9	1404.2	1407.5
43	1410.8	1414.0	1417.3	1420.6	1423.9	1427.2	1430.4	1433.7	1437.0	1440.3
44	1443.6	1446.9	1450.1	1453.4	1456.7	1460.0	1463.3	1466.5	1469.8	1473.1
45	1476.4	1479.7	1482.9	1486.2	1489.5	1492.8	1496.1	1499.3	1502.6	1505.9
46	1509.2	1512.5	1515.7	1519.0	1522.3	1525.6	1528.9	1532.2	1535.4	1538.7
47	1542.0	1545.3	1548.6	1551.8	1555.1	1558.4	1561.7	1565.0	1568.2	1571.5
48	1574.8	1578.1	1581.4	1584.6	1587.9	1591.2	1594.5	1597.8	1601.0	1604.3
49	1607.6	1610.9	1614.2	1617.5	1620.7	1624.0	1627.3	1630.6	1633.9	1637.1
50	1640.4	1643.7	1647.0	1650.3	1653.6	1656.8	1660.1	1663.4	1666.7	1669.9
51	1673.2	1676.5	1679.8	1683.1	1686.4	1689.6	1692.9	1696.2	1699.5	1702.8
52	1706.0	1709.3	1712.6	1715.9	1719.2	1722.4	1725.7	1729.0	1732.3	1735.6
53	1738.8	1742.1	1745.4	1748.7	1752.0	1755.2	1758.5	1761.8	1765.1	1768.4
54	1771.7	1774.9	1778.2	1781.5	1784.8	1788.1	1791.3	1794.6	1797.9	1801.2
55	1804.5	1807.8	1811.0	1814.3	1817.6	1820.9	1824.1	1827.4	1830.7	1834.0
56	1837.3	1840.6	1843.8	1847.1	1850.4	1853.7	1857.0	1860.2	1863.5	1866.8
57	1870.1	1873.4	1876.6	1879.9	1883.2	1886.5	1889.8	1893.0	1896.3	1899.6
58	1902.9	1906.2	1909.4	1912.7	1916.0	1919.3	1922.6	1925.9	1929.1	1932.4
59	1935.7	1939.0	1942.3	1945.5	1948.8	1952.1	1955.4	1958.7	1961.9	1965.2
60	1968.5	1971.8	1975.1	1978.3	1981.6	1984.9	1988.2	1991.5	1994.8	1998.0
61	2001.3	2004.6	2007.9	2011.1	2014.4	2017.7	2021.0	2024.3	2027.6	2030.8
62	2034.1	2037.4	2040.7	2044.0	2047.2	2050.5	2053.8	2057.1	2060.4	2063.6
63	2066.9	2070.2	2073.5	2076.8	2080.1	2083.3	2086.6	2089.9	2093.2	2096.5
64	2099.7	2103.0	2106.3	2109.6	2112.9	2116.1	2119.4	2122.7	2126.0	2129.3
65	2132.5	2135.8	2139.1	2142.4	2145.7	2149.0	2152.3	2155.5	2158.8	2162.1
66	2165.4	2168.6	2171.9	2175.2	2178.5	2181.8	2185.1	2188.3	2191.6	2194.9
67	2198.2	2201.5	2204.7	2208.0	2211.3	2214.6	2217.9	2221.1	2224.4	2227.7
68	2231.0	2234.3	2237.5	2240.8	2244.1	2247.4	2250.7	2253.9	2257.2	2260.5
69	2263.8	2267.1	2270.4	2273.6	2276.9	2280.2	2283.5	2286.8	2290.0	2293.3
70	2296.6	2299.9	2303.2	2306.4	2309.7	2313.0	2316.3	2319.6	2322.8	2326.1





Table 8. Kilometres to British Statute Miles

1 km. = 0.621372 mile

	0	1	2	3	4	5	6	7	8	9
—	—	0.621	1.243	1.864	2.485	3.107	3.728	4.350	4.971	5.592
1	6.214	6.835	7.456	8.078	8.699	9.321	9.942	10.563	11.185	11.806
2	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.777	17.398	18.020
3	18.641	19.263	19.884	20.505	21.127	21.748	22.369	22.991	23.612	24.234
4	24.855	25.476	26.098	26.719	27.340	27.962	28.583	29.204	29.826	30.447
5	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.418	36.040	36.661
6	37.282	37.904	38.525	39.146	39.768	40.389	41.011	41.632	42.253	42.875
7	43.496	44.117	44.739	45.360	45.982	46.603	47.224	47.846	48.467	49.088
8	49.710	50.331	50.952	51.574	52.195	52.817	53.438	54.059	54.681	55.302
9	55.923	56.545	57.166	57.788	58.409	59.030	59.652	60.273	60.894	61.516
10	62.137									

Table 9. Kilometres to British Nautical Miles

1 km. = 0.5396 nautical mile

	0	1	2	3	4	5	6	7	8	9
—	—	0.54	1.08	1.62	2.16	2.70	3.24	3.78	4.32	4.86
1	5.40	5.94	6.48	7.01	7.55	8.09	8.63	9.17	9.71	10.25
2	10.79	11.33	11.87	12.41	12.95	13.49	14.03	14.57	15.11	15.65
3	16.19	16.73	17.27	17.81	18.35	18.89	19.43	19.97	20.50	21.04
4	21.58	22.12	22.66	23.20	23.74	24.28	24.82	25.36	25.90	26.44
5	26.98	27.52	28.06	28.60	29.14	29.68	30.22	30.76	31.30	31.84
6	32.38	32.92	33.46	33.99	34.53	35.07	35.61	36.15	36.69	37.23
7	37.77	38.31	38.85	39.39	39.93	40.47	41.01	41.55	42.09	42.63
8	43.17	43.71	44.25	44.79	45.33	45.87	46.41	46.95	47.48	48.02
9	48.56	49.10	49.64	50.18	50.72	51.26	51.80	52.34	52.88	53.42
10	53.96									





Table 12. Square Kilometres to Square Miles

1 sq. km. = 0.386103 sq. mile

	0	1	2	3	4	5	6	7	8	9
—	—	0.386	0.772	1.158	1.544	1.931	2.317	2.703	3.089	3.475
1	3.861	4.247	4.633	5.019	5.405	5.792	6.178	6.564	6.950	7.336
2	7.722	8.108	8.494	8.880	9.266	9.653	10.039	10.425	10.811	11.197
3	11.583	11.969	12.355	12.741	13.128	13.514	13.900	14.286	14.672	15.058
4	15.444	15.830	16.216	16.602	16.989	17.375	17.761	18.147	18.533	18.919
5	19.305	19.691	20.077	20.463	20.850	21.236	21.622	22.008	22.394	22.780
6	23.166	23.552	23.938	24.324	24.711	25.097	25.483	25.869	26.255	26.641
7	27.027	27.413	27.799	28.186	28.572	28.958	29.344	29.730	30.116	30.502
8	30.888	31.274	31.660	32.047	32.433	32.819	33.205	33.591	33.977	34.363
9	34.749	35.135	35.521	35.908	36.294	36.680	37.066	37.452	37.838	38.224
10	38.610									

Table 13. Numbers per Square Kilometre to Numbers per Square Mile  
(or square miles to square kilometres)

1 sq. mile = 2.58998 sq. km.

	0	1	2	3	4	5	6	7	8	9
—	—	2.59	5.18	7.77	10.36	12.95	15.54	18.13	20.72	23.31
1	25.90	28.49	31.08	33.67	36.26	38.85	41.44	44.03	46.62	49.21
2	51.80	54.39	56.98	59.57	62.16	64.75	67.34	69.93	72.52	75.11
3	77.70	80.29	82.88	85.47	88.06	90.65	93.24	95.83	98.42	101.01
4	103.60	106.19	108.78	111.37	113.96	116.55	119.14	121.73	124.32	126.91
5	129.50	132.09	134.68	137.27	139.86	142.45	145.04	147.63	150.22	152.81
6	155.40	157.99	160.58	163.17	165.76	168.35	170.94	173.53	176.12	178.71
7	181.30	183.89	186.48	189.07	191.66	194.25	196.84	199.43	202.02	204.61
8	207.20	209.79	212.38	214.97	217.56	220.15	222.74	225.33	227.92	230.51
9	233.10	235.69	238.28	240.87	243.46	246.05	248.64	251.23	253.82	256.41
10	259.00									





Table 16. Litres to Gallons

1 l.=0.219976 gal.

	0	1	2	3	4	5	6	7	8	9
—	—	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
1	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.960	4.180
2	4.400	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
3	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
4	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.779
5	10.999	11.219	11.439	11.659	11.879	12.099	12.319	12.539	12.759	12.979
6	13.199	13.419	13.639	13.858	14.078	14.298	14.518	14.738	14.958	15.178
7	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
8	17.598	17.818	18.038	18.258	18.478	18.698	18.918	19.138	19.358	19.578
9	19.798	20.018	20.238	20.458	20.678	20.898	21.118	21.338	21.558	21.778
10	21.998									

Table 17. Kilogrammes to Pounds

1 kg.=2.20462 lb.

	0	1	2	3	4	5	6	7	8	9
—	—	2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842
1	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.478	39.683	41.888
2	44.092	46.297	48.502	50.706	52.911	55.115	57.320	59.525	61.729	63.934
3	66.139	68.343	70.548	72.752	74.957	77.162	79.366	81.571	83.776	85.980
4	88.185	90.389	92.594	94.799	97.003	99.208	101.413	103.617	105.822	108.026
5	110.231	112.436	114.640	116.845	119.049	121.254	123.459	125.663	127.868	130.073
6	132.277	134.482	136.686	138.891	141.096	143.300	145.505	147.710	149.914	152.119
7	154.323	156.528	158.733	160.937	163.142	165.346	167.551	169.756	171.960	174.165
8	176.370	178.574	180.779	182.983	185.188	187.393	189.597	191.802	194.007	196.211
9	198.416	200.620	202.825	205.030	207.234	209.439	211.644	213.848	216.053	218.257
10	220.462									



Table. 18. Temperature: Equivalents of Fahrenheit and Centigrade Scales

°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
212	100	192	88.8	172.4	78	153	67.2	133.25	56.25	114	45.5
211	99.4	191.75	88.75	172	77.7	152.6	67	133	56.1	113	45
210.2	99	191	88.3	171.5	77.5	152	66.6	132.8	56	112	44.4
210	98.8	190.4	88	171	77.2	151.25	66.25	132	55.5	111.2	44
209.75	98.75	190	87.7	170.6	77	151	66.1	131	55	111	43.8
209	98.3	189.5	87.5	170	76.6	150.8	66	130	54.4	110.75	43.75
208.4	98	189	87.2	169.25	76.25	150	65.5	129.2	54	110	43.3
208	97.7	188.6	87	169	76.1	149	65	129	53.8	109.4	43
207.5	97.5	188	86.6	168.8	76	148	64.4	128.75	53.75	109	42.7
207	97.2	187.25	86.25	168	75.5	147.2	64	128	53.3	108.5	42.5
206.6	97	187	86.1	167	75	146.75	63.8	127.4	53	108	42.2
206	96.6	186.8	86	166	74.4	146	63.75	127	52.7	107.6	42
205.25	96.25	186	85.5	165.2	74	145.4	63.3	126.5	52.5	107	41.6
205	96.1	185	85	165	73.8	145	63	126	52.2	106.25	41.25
204.8	96	184	84.4	164.75	73.75	144.5	62.7	125.6	52	106	41.1
204	95.5	183.2	84	164	73.3	144	62.5	125	51.6	105.8	41
203	95	183	83.8	163.4	73	143.6	62.2	124.25	51.25	105	40.5
202	94.4	182.75	83.75	163	72.7	143	61.6	123.8	51.1	104	40
201.2	94	182	83.3	162.5	72.5	142.25	61.25	123	51	103	39.4
201	93.8	181.4	83	162	72.2	142	61.1	122	50.5	102.2	39
200.75	93.75	181	82.7	161.6	72	141.8	61	121	50	102	38.8
200	93.3	180.5	82.5	161	71.6	141	60.5	120.2	49.4	101.75	38.75
199.4	93	180	82.2	160.25	71.25	140	60	120	49	101	38.3
199	92.7	179.6	82	160	71.1	139	59.4	119.75	48.8	100.4	38
198.5	92.5	179	81.6	159.8	71	138.2	59	119	48.75	100	37.7
198	92.2	178.25	81.25	159	70.5	138	58.8	118.4	48.3	99.5	37.5
197.6	92	178	81.1	158	70	137.75	58.75	118	48	99	37.2
197	91.6	177.8	81	157	69.4	137	58.3	117.5	47.7	98.6	37
196.25	91.25	177	80.5	156.2	69	136.4	58	117	47.5	98	36.6
196	91.1	176	80	156	68.8	136	57.7	116.6	47.2	97.25	36.25
195.8	91	175	79.4	155.75	68.75	135.5	57.5	116	47	97	36.1
195	90.5	174.2	79	155	68.3	135	57.2	115.25	46.6	96.8	36
194	90	174	78.8	154.4	68	134.6	57	115	46.25	96	35.5
193	89.4	173.75	78.75	154	67.7	134	56.6	114.8	46.1	95	35
192.2	89	173	78.3	153.5	67.5	134	56	114	46	94	34.4

Table 18 (continued). Temperature: Equivalents of Fahrenheit and Centigrade Scales

°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.	°F.	°C.
93.2	34	73	22.7	52.25	11.25	31	0.5	10.4	-12	-10	-23.3
93	33.8	72.5	22.5	52	11.1	30.2	1	10	-12.2	-10.75	-23.75
92.75	33.75	72	22.2	51.8	11	30	1.1	9.5	-12.5	-11	-23.8
92	33.3	71.6	22	51	10.5	29.75	1.25	9	-12.7	-11.2	-24
91.4	33	71	21.6	50	10	29	1.6	8.6	-13	-12	-24.4
91	32.7	70.25	21.25	49	9.4	28.4	2	8	-13.3	-13	-25
90.5	32.5	70	21.1	48.2	9	28	2.2	7.25	-13.75	-14	-25.5
90	32.2	69.8	21	48	8.8	27.5	2.5	7	-13.8	-14.8	-26
89.6	32	69	20.5	47.75	8.75	27	2.7	6.8	-14	-15	-26.1
89	31.6	68	20	47	8.3	26.6	3	6	-14.4	-15.25	-26.25
88.25	31.25	67	19.4	46.4	8	26	3.3	5	-15	-16	-26.6
88	31.1	66.2	19	46	7.7	25.25	3.75	4	-15.5	-16.6	-27
87.8	31	66	18.8	45.5	7.5	25	3.8	3.2	-16	-17	-27.2
87	30.5	65.75	18.75	45	7.2	24.8	4	3	-16.1	-17.5	-27.5
86	30	65	18.3	44.6	7	24	4.4	2.75	-16.25	-18	-27.7
85	29.4	64.4	18	44	6.6	23	5	2	-16.6	-18.4	-28
84.2	29	64	17.7	43.25	6.25	22	5.5	1.4	-17	-19	-28.3
84	28.8	63.5	17.5	43	6.1	21.2	6	1	-17.2	-19.75	-28.75
83.75	28.75	63	17.2	42.8	6	21	6.1	0.5	-17.5	-20	-28.8
83	28.3	62.6	17	42	5.5	20.75	6.25	0	-17.7	-20.2	-29
82.4	28	62	16.6	41	5	20	6.6	0.4	-18	-21	-29.4
82	27.7	61.25	16.25	40	4.4	19.4	7	—	-18.3	-22	-30
81.5	27.5	61	16.1	39.2	4	19	7.2	—	-18.75	-23	-30.5
81	27.2	60.8	16	39	3.8	18.5	7.5	—	-18.8	-23.8	-31
80.6	27	60	15.5	38.75	3.75	18	7.7	—	-19	-24	-31.1
80	26.6	59	15	38	3.3	17.6	8	—	-19.4	-24.25	-31.25
79.25	26.25	58	14.4	37.4	3	17	8.3	—	-20	-25	-31.6
79	26.1	57.2	14	37	2.7	16.25	8.75	—	-20.5	-25.6	-32
78.8	26	57	13.8	36.5	2.5	16	8.8	—	-21	-26	-32.2
78	25.5	56.75	13.75	36	2.2	15.8	9	—	-21.1	-26.5	-32.5
77	25	56	13.3	35.6	2	15	9.4	—	-21.25	-27	-32.7
76	24.4	55.4	13	35	1.6	14	10	—	-21.6	-27.4	-33
75.2	24	55	12.7	34.25	1.25	13	10.5	—	-22	-28	-33.3
75	23.8	54.5	12.5	34	1.1	12.2	11	—	-22.2	-28.75	-33.75
74.75	23.75	54	12.2	33.8	1	12	11.1	—	-22.5	-29	-33.8
74	23.3	53.6	12	33	0.5	11.75	11.25	—	-22.7	-29.2	-34
73.4	23	53	11.6	32	0	11	11.6	—	-23	-30	-34.4



Table 19. Pressure: Equivalents of Millibars, Millimetres of Mercury, and Inches of Mercury at  $32^{\circ}$  F. in Latitude  $45^{\circ}$ 

Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.	Mercury in.	Milli- bars	Mercury mm.
27.02	915	686.3	27.82	942	706.6	28.62	969	726.8	29.41	996	747.1
27.05	916	687.1	27.85	943	707.3	28.65	970	727.6	29.44	997	747.8
27.08	917	687.8	27.88	944	708.1	28.67	971	728.3	29.47	998	748.6
27.11	918	688.6	27.91	945	708.8	28.70	972	729.1	29.50	999	749.3
27.14	919	689.3	27.94	946	709.6	28.73	973	729.8	29.53	1,000	750.1
27.17	920	690.1	27.97	947	710.3	28.76	974	730.6	29.56	1,001	750.8
27.20	921	690.8	28.00	948	711.1	28.79	975	731.3	29.59	1,002	751.6
27.23	922	691.6	28.03	949	711.8	28.82	976	732.1	29.62	1,003	752.3
27.26	923	692.3	28.05	950	712.6	28.85	977	732.8	29.65	1,004	753.1
27.29	924	693.1	28.08	951	713.3	28.88	978	733.6	29.68	1,005	753.8
27.32	925	693.8	28.11	952	714.1	28.91	979	734.3	29.71	1,006	754.6
27.35	926	694.6	28.14	953	714.8	28.94	980	735.1	29.74	1,007	755.3
27.38	927	695.3	28.17	954	715.6	28.97	981	735.8	29.77	1,008	756.1
27.41	928	696.1	28.20	955	716.3	29.00	982	736.6	29.80	1,009	756.8
27.44	929	696.8	28.23	956	717.1	29.03	983	737.3	29.83	1,010	757.6
27.46	930	697.6	28.26	957	717.8	29.06	984	738.1	29.86	1,011	758.3
27.49	931	698.3	28.29	958	718.6	29.09	985	738.8	29.89	1,012	759.1
27.52	932	699.1	28.32	959	719.3	29.12	986	739.6	29.92	1,013	759.8
27.55	933	699.8	28.35	960	720.1	29.15	987	740.3	29.94	1,014	760.6
27.58	934	700.6	28.38	961	720.8	29.18	988	741.1	29.97	1,015	761.3
27.61	935	701.3	28.41	962	721.6	29.21	989	741.8	30.00	1,016	762.1
27.64	936	702.1	28.44	963	722.3	29.24	990	742.6	30.03	1,017	762.8
27.67	937	702.8	28.47	964	723.1	29.26	991	743.3	30.06	1,018	763.6
27.70	938	703.6	28.50	965	723.8	29.29	992	744.1	30.09	1,019	764.3
27.73	939	704.3	28.53	966	724.6	29.32	993	744.8	30.12	1,020	765.1
27.76	940	705.1	28.56	967	725.3	29.35	994	745.6	30.15	1,021	765.8
27.79	941	705.8	28.59	968	726.1	29.38	995	746.3	30.18	1,022	766.6

Table 20. Conversion table for Petroleum Products. Volume per unit weight and weight per unit volume of liquid\*

Sp. gravity	Volume per long ton† in				Weight in long tons‡ per			
	Cu.m.§	Imp. gal.	Amer. gal.	Amer. barrels	Cu.m.	Imp. gal.	Amer. gal.	Amer. barrels
0.650	1.57	345	414	9.9	0.638	0.00290	0.00242	0.101
0.700	1.46	320	384	9.2	0.687	0.00312	0.00260	0.109
0.750	1.36	299	359	8.5	0.736	0.00335	0.00279	0.117
0.800	1.27	280	336	8.0	0.786	0.00357	0.00297	0.125
0.850	1.20	264	317	7.5	0.835	0.00379	0.00316	0.133
0.900	1.13	249	299	7.1	0.884	0.00402	0.00335	0.141
0.950	1.07	236	283	6.7	0.933	0.00424	0.00353	0.148
1.000	1.02	224	269	6.4	0.982	0.00447	0.00372	0.156

\* The figures in this table are only approximate.

† To obtain volume per metric ton multiply figures in table by 0.98421.

‡ To obtain weights in metric tons multiply figures in table by 1.01605.

§ 1 cu.m. = 10 hectolitres (approximate).

The specific gravity of a product must be known in order to calculate accurately equivalent weights and volumes from the above table. The following table shows how widely the specific gravities of crude oils and commercial petroleum products may vary, and will indicate the degree of error involved in assumption of approximate specific gravity figures.

Product	Specific gravity range	Product	Specific gravity range
Crude oils	0.800-0.970	Diesel oils	0.820-0.920
Aviation gasolines	0.700-0.780	Lubricating oils	0.850-0.950
Motor gasolines	0.710-0.790	Fuel oils	0.920-0.990
Kerosines	0.780-0.840	Asphaltic bitumens	1.000-1.100
Gas oils	0.820-0.900		

Thus, if the specific gravity of a crude oil is assumed to be 0.850, a production of 10,000 long tons is equivalent to

$$7.5 \times 10,000 = 75,000 \text{ American barrels;}$$

whereas, if its true specific gravity is 0.950, the production is only 67,000 American barrels.





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